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U.S. FEDERAL TRADE COMMISSIO

REPORT

ON THE

FERTILIZER INDUS

AUGUST 19, 1916

WASHINGTON
GOVERNMENT PRINTING OFFICE
1916

U.S. FEDERAL TRADE COMMISSION

REPORT

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CONTENTS.

Page.
Letter of submittal xiii

CHAPTER I.—INTRODUCTION AND SUMMARY.

Section 1. Scope of the report 1
2. Conclusions regarding prices 2
  Wholesale prices of materials 2
  Retail prices of materials 2
  Retail prices of mixed fertilizers 3
3. Principal fertilizer materials 3
  Nitrogenous materials 4
  Phosphates 4
  Potash 5
  Statistics of consumption 5
4. Fertilizer middlemen 6
  Exclusive selling agents 7
  Brokers 7
  Importers 8
  Distributing houses 9
  Local dealers 9
5. Fertilizer manufacturers and dry mixers 9
  Operations 9
  Selling methods 10
  Control of dry mixers 10
  Identification of subsidiaries 11
  Multiplication of brands 11
  Costs and profits 11
6. State fertilizer control laws 12
  Regulations 12
  Analysis of fertilizers 13
  Fertilizer taxes 14
7. Summary of conclusions 15

CHAPTER II.—PRODUCTION AND SALE OF INORGANIC NITRATES AND AMMONIATES.

Section 1. Introduction 17
2. Nitrate of soda 17
  Sources of nitrate of soda 17
  Chilean nitrate deposits 18
  Process of mining and refining 18
  Cost of producing nitrate 19
  Growth of nitrate industry 21
  Nitrate companies 23

Section 2. Nitrate of soda—Continued.

Page.
Combinations of nitrate producers 23
Nitrate propaganda 25
Exportation of nitrate 26
Consumption of nitrate 28
American importers 30
3. Air nitrates 32
Calcium cyanamid 33
The American Cyanamid Co 34
Nitrate of lime 35
Distribution of foreign air nitrates 36
4. Sulphate of ammonia 36
Sources of sulphate 37
Description of the coking process 38
Other processes of production 39
Types of by-product coke ovens 40
Domestic production 42
Relative production of ammonia liquor and sulphate of ammonia. 43
Imports of sulphate of ammonia 44
Consumption of sulphate of ammonia in the United States 45
Production and sale of sulphate in Europe 46
Terms of sale 48
Sales of sulphate of ammonia by American Coal Products Co 49
Corporate organization of American Coal Products Co 51
Sales policy of American Coal Products Co 52
Sulphate propaganda 53

CHAPTER III.—PRODUCTION AND SALE OF ORGANIC AMMONIATES.

Section 1. Introduction 55
2. Cottonseed meal 55
Uses of cottonseed meal 56
Process of manufacture 56
Statistics of the industry 57
Sale of cottonseed meal 58
Principal producers 60
Southern Cotton Oil Co 60
American Cotton Oil Co 61
Buckeye Cotton Oil Co 62
Other companies 62
Agreements in restraint of trade 65
3. Tankage and dried blood 66
Process of production 66
Producers 67
Purchases by producers 69
Imports of tankage and dried blood 69
Storage facilities 70
Estimated domestic production 70
Production and purchases of large packers 72
Uses 72
Terms of sale 74
Speculation in tankage 76

Page.
Section 4. Proprietary tankages and base goods.......... 76
  Proprietary tankages.......... 77
  Base goods.......... 78
5. Fish scrap.......... 79
  Producers.......... 79
  Menhaden industry.......... 80
  Process of production.......... 81
  Statistics of production.......... 82
  Use of fish scrap.......... 83
  Terms of sale.......... 83 ✓
  Speculation in fish scrap.......... 83
  Concentration of fish-scrap factories.......... 84

CHAPTER IV.—PRODUCTION AND SALE OF PHOSPHATES.

Section 1. Introduction.......... 86
2. Basic slag.......... 86
3. Bone products.......... 88
4. Acid phosphate.......... 88
  Process of manufacture.......... 89
  Principal producers.......... 90
  Cost of production.......... 91
  Sale of acid phosphate.......... 94
5. Phosphate rock.......... 94
  Raw rock phosphate.......... 97
  Florida phosphate rock.......... 97
  Tennessee phosphate rock.......... 99
  Processes of mining.......... 100
  Cost of mining.......... 101
6. Sulphuric acid.......... 101
  Process of production.......... 102
  Principal producers.......... 102
  Sales of acid.......... 103 ✓

CHAPTER V.—PRODUCTION AND SALE OF POTASH SALTS.

Section 1. Introduction.......... 104
  Sources of potash.......... 104
2. The German potash industry.......... 105
  Importance of the industry.......... 105
  Extent of deposits.......... 105
  Growth of industry.......... 106
  Mining and refining.......... 107
3. The Potash Syndicate.......... 108
  History.......... 108
  The potash law of May 25, 1910.......... 110
  The potash controversy with the United States.......... 112
  Restriction of new mines.......... 113
4. Sales of potash in the United States.......... 114
  The five fertilizer contracts.......... 116
  Terms of sale.......... 117 ✓
  German Kali Works.......... 119

CHAPTER VI.—WHOLESALE PRICES OF FERTILIZER MATERIALS.

Page.
Section 1. Introduction.... 120
Price fluctuations.... 120
Causes of price fluctuations.... 121
2. Nitrate of soda.... 122
Price fluctuations.... 124
Causes of major price fluctuations.... 125
Influence of importers upon domestic prices.... 129
3. Sulphate of ammonia.... 129
Price fluctuations.... 134
Causes of major price fluctuations.... 134
Influence of the American Coal Products Co. upon prices.... 138
4. Cottonseed meal.... 138
Price fluctuations.... 140
Causes of major price fluctuations.... 141
Influence of cottonseed combinations upon prices.... 144
5. Tankage, dried blood and fish scrap.... 144
Price fluctuations.... 147
Causes of major price fluctuations.... 148
Influence of packers on prices.... 150
6. Acid phosphate and phosphate rock.... 151
Price fluctuations.... 153
Causes of the decline.... 154
7. German potash salts.... 155
8. Comparative prices of nitrates and ammoniates.... 156

CHAPTER VII.—COMPARISON OF WHOLESALE PRICES AND FARMERS' PRICES OF FERTILIZER MATERIALS.

Section 1. Introduction.... 161
2. Farmers' prices of fertilizer materials.... 162
Nitrate of soda.... 164
Acid phosphate.... 165
Potash salts.... 167
Cottonseed meal.... 168

CHAPTER VIII.—THE PRODUCTION AND SALE OF MIXED FERTILIZERS.

Section 1. Introduction.... 170
2. Principal fertilizer manufacturers.... 172
3. Fertilizer plants in the United States.... 177
4. Operation of controlled companies as independents.... 179
5. Virginia-Carolina Chemical Co.... 181
Organization and capitalization.... 181
Good-will account.... 182
Companies acquired.... 182
Identification of companies.... 184
Plants operated.... 185
Southern Cotton Oil Co.... 186
Affiliated companies.... 188
Extent of fertilizer control.... 189
Mining and other companies.... 190

Page.
Section 6. The American Agricultural Chemical Co........ 191
Organization and capitalization........ 191
Good-will account........ 192
Companies acquired........ 192
Identification of companies........ 194
Number of fertilizer plants operated........ 195
Selling companies........ 197
Phosphate properties and mining companies........ 199
Miscellaneous activities........ 200
7. Armour Fertilizer Works........ 200
Organization and capitalization........ 200
Identification of companies........ 201
Number of plants operated........ 201
Companies controlled through intermediaries........ 202
Mining properties........ 203
8. International Agricultural Corporation........ 203
Organization and capitalization........ 203
Subsidiary and affiliated fertilizer companies........ 204
Identification of companies........ 205
Number of plants operated........ 206
Phosphate-mining properties........ 207
Potash properties........ 208
9. F. S. Royster Guano Co........ 208
Organization and capitalization........ 208
10. Swift & Co........ 209
11. Baugh & Sons Cos........ 211
12. Other important companies........ 212
13. Selling methods of principal companies........ 214
The middleman........ 214
Credit conditions........ 215
Price basis........ 215
Terms of contracts........ 216
Operation of subsidiary and affiliated companies........ 217
Multiplication of brands........ 218
14. Sales, costs, and profits of principal fertilizer manufacturers........ 223
Profit on investment........ 228
15. Comparison of mixed fertilizer prices with prices of materials........ 230
Economy of home mixing........ 233
Obstacles to home mixing........ 236
Rural credit system........ 237
16. Former agreements in restraint of trade........ 240
Colonial Development Co........ 240
17. Present tendencies........ 243
Control of materials........ 244
Index........ 247

LIST OF TABLES.

Table 1.—Estimated consumption of high-grade materials in commercial fertilizers for the year 1913........ 6
Table 2.—Maximum, minimum, and average cost of nitrate of soda in Chile in 1903........ 19
Table 3.—Percentages of the total exports of Chilean nitrate produced by interests of different nationalities in various years from 1895 to 1912........ 22
Table 4.—Statistics of the Chilean nitrate industry, 1904–1913........ 22

Page.
Table 5.—Nitrate exports from Chile, by principal concerns, 1910–1913....... 26
Table 6.—Nitrate exports from Chile to Europe, the United States, and other countries, by years, 1907–1913........ 27
Table 7.—Consumption of nitrate of soda in the principal world markets, 1909–1913........ 29
Table 8.—Estimated imports of nitrate of soda into the United States, by companies, calendar year 1913........ 31
Table 9.—Domestic production of sulphate of ammonia, by years, 1907–1913. 42
Table 10.—Imports of sulphate of ammonia into the United States, by countries, for the calendar years 1907–1913........ 45
Table 11.—Domestic consumption of sulphate of ammonia, 1907–1913........ 46
Table 12.—Sulphate of ammonia and equivalent produced and consumed in Germany, France, and the United Kingdom, 1908–1913........ 47
Table 13.—Exports of sulphate of ammonia from United Kingdom to principal countries, by years, 1909–1913........ 48
Table 14.—Total sales of domestic sulphate of ammonia, sales by American Coal Products Co., and percentage of such sales to total, by years, 1907–1913..... 50
Table 15.—Sales of domestic sulphate of ammonia, imports, and total sales, also sales by the American Coal Products Co. and percentage of such sales to the total, by years, 1907–1913........ 50
Table 16.—Total sales of sulphate of ammonia by the American Coal Products Co., quantity sold directly, through brokers, and to wholesalers and retailers, and percentage of such sales to total, by years, 1907–1913........ 53
Table 17.—Tons of cotton seed produced and crushed and the production, exportation, and domestic consumption of cottonseed cake and meal, by years, 1902–1914........ 58
Table 18.—Number of crude-oil mills and dry-mixing plants operated by the Southern Cotton Oil Co. in 1914........ 60
Table 19.—Crude-oil mills and number of mills engaged in mixing fertilizer operated by the American Cotton Oil Co........ 62
Table 20.—Location of the principal abattoirs of the five largest packing companies........ 68
Table 21.—Statistics of the menhaden industry of the Atlantic coast States in 1912........ 82
Table 22.—Statistics of the menhaden industry of the Atlantic coast States in 1913........ 82
Table 23.—World's production of basic-slag phosphate, 1907–1913........ 87
Table 24.—Average cost per net ton of producing acid phosphate at 19 plants, grouped according to geographical location, fiscal year 1913........ 92
Table 25.—Average cost per net ton of producing acid phosphate at Baltimore, Savannah, Atlanta, and at Americus, Augusta, and Macon combined, fiscal year 1913........ 93
Table 26.—Tons of acid phosphate consumed in mixed goods and tons sold in bags and in bulk by seven large fertilizer manufacturers during the season of 1913........ 94
Table 27.—Annual marketed production of phosphate rock by States, together with imports, exports, and domestic consumption, 1904–1914........ 95
Table 28.—World's production of phosphate rock and apatite, by countries, 1907–1913........ 96
Table 29.—Holdings of phosphate lands in Florida, estimated tonnage in ground, and tons mined, by companies, in 1913........ 99
Table 30.—Holdings of phosphate lands in Tennessee, estimated tonnage in ground, and tons mined, by companies, in 1913........ 100

Page.

Table 31.—Total quantities of crude salts extracted from mines of the German Potash Syndicate, 1890–1913 106
Table 32.—Total sales of pure potash (K_2O), 1909–1913 107
Table 33.—Shipments of potash salts of all kinds to the United States for fertilizer and for chemical purposes, and potash equivalent, 1904–1914 115
Table 34.—Total quantities of potash salts sold in the United States by the German Potash Syndicate on the five fertilizer contracts through the German Kali Works and to chemical companies, calendar year 1913 117
Table 35.—Average monthly spot prices per 100 pounds of nitrate of soda in the principal world markets, 1906–1914 123
Table 36.—Average monthly spot prices per 100 pounds of foreign sulphate of ammonia in the principal world markets, 1907–1914 131
Table 37.—Average monthly prices per 100 pounds of domestic sulphate of ammonia, for producers and brokers, 1907–1914 132
Table 38.—Average monthly prices per net ton of prime cottonseed meal, for prompt transactions, f. o. b. mill, by States, 1907–1914 139
Table 39.—Corn, cotton, and cottonseed meal and cake produced and cottonseed meal and cake exported, 1907–1914 141
Table 40.—Average price, per unit of ammonia, of high-grade ground tankage, f. o. b. Chicago, by months, 1908–1914 145
Table 41.—Average price, per unit of ammonia, of dried blood, f. o. b. Chicago, by months, 1908–1914 146
Table 42.—Average price, per unit of ammonia, of high-grade ground tankage and dried blood, for sales by producers, f. o. b. New York, by months, 1907–1914 146
Table 43.—Average price, per unit of ammonia, of dried fish scrap, delivered Chesapeake Bay points, by months, 1907–1914 147
Table 44.—Average prices per net ton, f. o. b. plant, of 16 per cent bulk acid phosphate for various plants, by months, 1908–1914 151
Table 45.—High, low, and mean contract prices per gross ton of Florida land pebble phosphate rock, at mines, by months, 1908–1914 153
Table 46.—High, low, and mean contract prices per gross ton of Tennessee brown phosphate rock, at mines, by months, 1910–1914 153
Table 47.—Wholesale prices per net ton of potash salts, c. i. f. Atlantic ports, 1910–1914 155
Table 48.—Comparison of average monthly prices per unit of nitrogen of the principal organic and inorganic nitrates and ammoniates, 1909–1914 157
Table 49.—Comparison of average wholesale spot prices of nitrate of soda, c. i. f. Baltimore and Charleston, with average cash prices of distributors to merchants and farmers f. o. b. Norfolk, Charleston, and Savannah, by months, January to June, 1914 164
Table 50.—Comparison of average wholesale prices of 16 per cent bulk acid phosphate per ton, f. o. b. Baltimore and Savannah, with average cash prices of distributors to merchants and farmers f. o. b. Norfolk, Charleston, and Savannah, by months, January to June, 1914 165
Table 51.—Comparison of wholesale net prices of kainit, c. i. f. Atlantic ports, with average cash prices of distributors, to merchants and farmers f. o. b. Norfolk, Charleston, and Savannah, by months, January to June, 1914 167
Table 52.—Comparison of wholesale net prices of muriate of potash, c. i. f. Atlantic ports, with average cash prices of distributors to merchants and farmers, f. o. b. Norfolk, Charleston, and Savannah, by months, January to June, 1914 167
Table 53.—Estimated consumption of commercial fertilizer in the United States and per cent of total by States, 1909–1914 171

Page.
Table 54.—Capital stock outstanding and funded indebtedness of principal fertilizer manufacturers in 1914 172
Table 55.—Fertilizer sold in bags and in bulk by the seven largest companies for the season of 1913 173
Table 56.—Principal high-grade fertilizer materials used in mixed goods by the seven largest companies during season of 1913 173
Table 57.—Estimated proportion of high-grade nitrogenous materials consumed in mixed goods by seven largest companies, fiscal year 1913 175
Table 58.—Fertilizer sales as indicated by tag-tax receipts of the seven large companies in four Southern States, total sales, and percentage of such sales to total, 1914 season 176
Table 59.—Number and character of fertilizer plants in operation, by States, 1914 178
Table 60.—Number of plants in the United States operated by seven largest fertilizer companies, by classes, totals and percentages, 1914 179
Table 61.—Number and character of fertilizer plants operated by Virginia-Carolina Chemical Co., proper, and by subsidiary and affiliated companies, and totals, by States, 1914 185
Table 62.—List of cotton-oil mills belonging to the Southern Cotton Oil Co. and mixing capacity of fertilizer plants, 1914 186
Table 63.—Plants operated by the Virginia-Carolina Chemical Co. and other companies in the States of Alabama, Georgia, and South Carolina, by classes, 1914 190
Table 64.—Number and character of fertilizer plants operated by The American Agricultural Chemical Co. proper, and by subsidiary companies, and totals, by States, 1914 196
Table 65.—Number and character of fertilizer plants operated by Armour Fertilizer Works proper, and by subsidiary companies, and totals, by States, 1914 202
Table 66.—Number and character of fertilizer plants operated by the International Agricultural Corporation proper, and by subsidiary and affiliated companies, and totals, by States, 1914 207
Table 67.—Number of brands registered by fertilizer manufacturers in four Northern States in 1913 season and in four Southern States in 1914 season.... 218
Table 68.—Number of brands of certain formulas registered in State of South Carolina by seven largest companies, 1913–14 season 220
Table 69.—Combined statement of sales, costs, and profits from fertilizer business of four large companies, fiscal years 1910–1914 224
Table 70.—Combined statement of per cent of costs and profits to net sales of four large companies, fiscal years 1910–1914 227
Table 71.—Net book investment (exclusive of good will), operating profit, and per cent of profit on such investment of four large companies, by fiscal years, 1910–1914 228
Table 72.—Rates of profit on net sales and net book investment, exclusive of good will, by companies and combined, by fiscal years, 1910–1914 229
Table 73.—Estimated cost of materials, per ton and per unit, at interior delivery points in Georgia and South Carolina, 1914 231
Table 74.—Estimated cost of materials in five important formulas to farmers in Georgia and South Carolina, 1914 232

LIST OF DIAGRAMS.

Facing page.

Diagram 1.—Average prices of nitrate of soda, principal world markets; comparison of nitrate prices, Hamburg and Chile alongside and Chile plus freight; and raw beet sugar prices, Hamburg, by months, 1906–1914 124

Diagram 2.—Average prices of foreign sulphate of ammonia, principal world markets, and of domestic sulphate of ammonia f. o. b. plant, United States; comparison of brokers' and producers' prices, United States; comparison of sulphate of ammonia and nitrate of soda prices, Hamburg, by months, 1907–1914 134

Diagram 3.—Average prices of prime cottonseed meal f. o. b. mill by States and all States combined, and mean prices of No. 2 corn, Chicago, by months, 1907–1914 140

Diagram 4.—Average prices per unit of ammonia of high-grade tankage and dried blood f. o. b. Chicago and New York, and of dried fish scrap delivered Chesapeake Bay points, and mean prices of middling cotton, New Orleans, by months, 1908–1914 146

Diagram 5.—Average prices f. o. b. plant of 16 per cent bulk acid phosphate, and mean prices at mines of Florida and Tennessee phosphate rock, by month, 1908–1914 152

Diagram 6.—Average prices per unit of nitrogen of the principal organic and inorganic nitrates and ammoniates, United States, by months, 1909–1914 158

LIST OF CHARTS.

Corporate Organization of Virginia-Carolina Chemical Co 184

Corporate Organization of The American Agricultural Chemical Co 194

Corporate Organization of Armour Fertilizer Works 200

Corporate Organization of International Agricultural Corporation 206

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The Commission desires to mention as especially contributing to the preparation of this report Messrs. E. O. Merchant and F. L. Hawes. Mr. W. W. Bays also rendered valuable assistance.

LETTER OF SUBMITTAL.

Federal Trade Commission,
Washington August 19, 1916.

To the President of the Senate of the United States.

Sir: There is submitted herewith a report on the fertilizer industry, the investigation of which was begun by the Bureau of Corporations pursuant to Senate resolution 487, Sixty-second Congress, third session, and was transferred to the Federal Trade Commission on its organization March 16, 1915.

The economic importance of the fertilizer industry, which embraces the production and sale of various fertilizer materials, as well as the manufacture and sale of prepared or mixed fertilizers, is shown by the fact that the value of all commercial fertilizers consumed in 1914 was in excess of $150,000,000.

FEATURES OF THE REPORT.

The following facts set forth by the report are of special public interest:

FERTILIZER MATERIALS.

1. The wholesale prices of nitrogenous and phosphatic fertilizer materials have been governed fundamentally by conditions of supply and demand during the period covered by the investigation, although artificial conditions have at times exerted at least a temporary influence.

2. The wholesale prices of German potash salts have been arbitrarily controlled by a syndicate of producers, of which the Prussian Government is a member, competition in prices having been eliminated since 1910 by an Imperial law.

3. Farmers' prices of fertilizer materials for cash purchases in carload quantities have compared favorably with wholesale prices, but farmers' credit prices have often been excessively high.

MIXED FERTILIZERS.

4. Most of the fertilizers used in this country are purchased in mixed form and not in the form of materials. In the mixed fertilizer industry there are about 800 concerns operating some 1,200 plants, but the seven largest companies, with their numerous subsidiary and

affiliated concerns, control more than 58 per cent of the total output. The two largest sell annually over a million tons each, and in the aggregate about 34 per cent of the total output.

5. The prices paid by farmers for mixed fertilizers have been high in comparison with the cash value of the constituent elements, partly because of credit conditions and the expensive distributing methods of the large fertilizer companies; for these reasons also the profits of the large companies have not been large.

CREDIT CONDITIONS.

6. Credit conditions affecting farmers are so burdensome that some action, legislative or otherwise, should be taken to remedy them. Any action that would reduce the high interest rates on agricultural credits, particularly on short-time loans, would tend to reduce farmers' prices, both of fertilizer materials and mixed fertilizers.

SELLING METHODS.

7. Objectionable selling methods of some of the large mixed fertilizer manufacturers have been the unnecessary multiplication of brands and the operation of controlled companies as independents.

NITROGENOUS AND PHOSPHATIC FERTILIZER PRICES CONTROLLED BY SUPPLY AND DEMAND.

The variety of materials, both domestic and imported, used as sources of nitrogen and of phosphorus for fertilizers has made it practically impossible to control their prices. While each material, as a rule, has special characteristics which make it particularly desirable for certain crops, there are other materials sufficiently similar in action and availability to cause a substitution of one for another, when differences in prices make it worth while.

As a result of this possibility of substituting one material for another the various combinations of nitrate producers in Chile have had but little effect upon the course of prices of nitrate of soda, notwithstanding the fact that this is the principal source of supply. Similarly the American Coal Products Co., which has exclusive contracts with producers for the sale of nearly 90 per cent of the domestic output of sulphate of ammonia, has not been in a position to control the prices in the United States, because of the competition of foreign sulphate and other nitrogenous materials.

High prices for sugar beets, cotton, and other crops on which fertilizers are extensively used stimulate the demand for fertilizers and thus tend to increase fertilizer prices, while low prices of such crops tend to have the opposite effect. Changes in the prices of most of the nitrogenous and phosphatic fertilizer materials, except nitrate of soda and acid phosphate, do not have much effect on the output since they are by-products of other industries.

The prices of the two most important inorganic fertilizers—nitrate of soda and sulphate of ammonia—are fixed in the European market where the consumption is greatest, domestic prices following the prices in Europe. The prices of the organic materials, such as cottonseed meal, tankage, dried blood, and fish scrap are influenced largely by domestic conditions. Cottonseed-meal prices are especially affected by the prices of corn, with which it competes as a stock food, while the prices of tankage, dried blood, and fish scrap are especially affected by the price of cotton, upon which crop mixed fertilizers containing these materials are most extensively used.

The prices of phosphate rock and acid phosphate—the principal phosphatic materials—are also determined largely by domestic conditions, among which may be mentioned the prices of cotton on the demand side and the tendency to overproduction of Florida phosphate rock and of sulphuric acid on the supply side, these two materials being the constituents of acid phosphate.

MONOPOLY PRICES OF POTASH SALTS.

Germany has a natural monopoly of soluble potash salts used for fertilizer, no deposits of similar quality and accessibility having as yet been developed in any other country. Furthermore, there are no other sources of potassium now capable of supplying the demand of the fertilizer markets. The sales of German potash salts are handled by a syndicate of mine owners, which fixes wholesale prices in all countries. The Prussian Government is a large owner of potash mines and a member of the syndicate. The syndicate is protected by the German Government, which, by the law of May 25, 1910, relating to the sale of potash salts, practically eliminated all price competition among the producers.

FARMERS' PRICES OF MATERIALS OFTEN EXCESSIVELY HIGH.

The report shows that considerable quantities of nitrate of soda, cottonseed meal, acid phosphate, and potash salts are purchased by farmers who prepare their own mixtures or apply the materials to the soil in unmixed form. Farmers who are able to pay cash and buy in carload quantities obtain prices that compare very favorably with the wholesale prices paid by manufacturers, but farmers who buy in small quantities and on credit often pay excessively high prices. Instances have been found where the retail credit prices of acid phosphate, for example, were more than double the wholesale price.

DOMINANT POSITION OF MIXED FERTILIZER INDUSTRY.

Approximately 80 per cent of the total consumption of fertilizers, which in 1913 was estimated at 6,750,000 tons and in 1914 at more than 7,500,000 tons, is in the form of mixed goods and not in the form of materials.

The mixed-fertilizer industry comprises about 800 concerns operating approximately 1,200 plants. Many of these are small dry-mixing concerns which do only a local business. There are, however, several large corporations in the business which have numerous plants scattered over the country and which also control a number of other concerns engaged in the same business. Two of these corporations, the Virginia-Carolina Chemical Co. and The American Agricultural Chemical Co. have an annual output of more than 1,000,000 tons each. Taken together, they sold in 1913 more than 2,300,000 tons of fertilizer, or over 34 per cent of the total domestic consumption, while the five next largest concerns, taken together, sold more than 1,600,000 tons, or about 24 per cent. These seven largest concerns, with their controlled companies, operate only about 25 per cent of the total number of plants, but do more than 58 per cent of the fertilizer business of the country.

The advantages of the larger concerns lie principally in their superior facilities for furnishing credit and their ability to equalize the risks incident to bad seasons in particular localities by doing business over a large territory. During recent years, however, the small concerns have had certain advantages over the large companies which have made it possible for them to thrive. They are in closer touch with their customers, so that the expenses of distribution, such as advertising, salesmen's expenses, etc., are smaller and they enjoy a good will among certain local customers not enjoyed by the large corporations. They have also been able to obtain their materials at prices but little higher than those paid by the large concerns. The large companies have in some cases attempted to secure for themselves the advantages of the small concerns by acquiring a controlling interest in them.

FARMERS' PRICES OF MIXED FERTILIZER TOO HIGH.

The report shows that on account of credit conditions, distributing methods, etc., farmers' prices of mixed fertilizer are, as a rule, excessively high when compared with the cash value of the constituent materials. Farmers having the cash and the initiative, by buying the materials and mixing them at home, have usually been able to save from $4 to $8 a ton. This possible saving by paying cash for materials and practicing home mixing can not be attained by most farmers, because they do not have the money and either can not borrow it at all or only on terms that are practically prohibitive.

The European war has resulted in an increase in farmers' prices of mixed fertilizer not only by increasing the cost of some of the constituent materials, but also by impairing the competitive forces which the large manufacturers have usually encountered from the local dry mixer and the home mixer. In the 1915 season the small dry mixer did not have the potash to compete successfully, and the farmer was unable to buy potash and do his own mixing. The large fertilizer manufacturers raised their list prices and were successful in realizing most of the increase, since discounts and allowances remained about the same. As a result, some of them made larger profits than they did in 1914 in spite of a considerable decrease in tonnage.

PROFITS OF MOST IMPORTANT COMPANIES NOT LARGE.

Statements of earnings and expenses obtained from four large fertilizer companies for the period 1910 to 1914, inclusive, show that while sales increased rapidly expenses increased more rapidly and profits declined. The combined statement of the four companies for the five-year period shows that while net sales increased 42 per cent total expense increased 54 per cent and profits decreased 18 per cent. The increase in manufacturing cost and selling expense was about equal.

For the year 1914 the cost of materials for these four companies combined was 67.8 per cent of net sales, and the other manufacturing costs 13.2 per cent. The selling expenses were 6.8 per cent of the net sales and the general and administrative expenses 2.3 per cent. The total operating expenses amounted to 90.1 per cent of net sales, leaving 9.9 per cent for profits. The profits in 1910, the best year, were 17.2 per cent of net sales, and in 1912, the poorest year, 8.2 per cent. Based on the total net investment, as shown by the books, the rate of profit for the four companies combined was 9.5 per cent in 1910, the best year; 4.2 per cent in 1912, the poorest year; and 6.1 per cent in 1914.

THE PROBLEM OF PERSONAL CREDITS.

Present credit conditions affecting farm mortgages and short-time loans, particularly in the South, are exceptionally burdensome. Many small landowners and most tenants can not borrow money at all or only at extortionately high rates of interest. The tenant class, which in many parts of the South comprises from 60 to 90 per cent of the farmers, must rely entirely upon personal credit for fertilizers and other supplies. The risks are large and the interest rates accordingly high.

The adoption of a rural credit system which would reduce the interest rates on personal credits and at the same time reduce the risks to the lender would undoubtedly enable the tenant farmer to obtain his fertilizers either in mixed form or in the form of materials at considerable reduction from the prices prevailing in recent years. Federal legislation to enable credit to be furnished at reasonable interest rates on land mortgages such as has recently been enacted by the Congress will tend to improve the situation as respects the small landowner but can have little, if any, effect on the personal-credit problem and consequently little effect upon fertilizer prices for the large tenant class. Further legislation by the Federal Government or by the various States, or cooperative action by the farmers themselves, is needed to meet this situation.

USELESS MULTIPLICATION OF BRANDS.

Under present conditions the use of brand names in the sale of mixed fertilizers may be necessary. At least, experience has shown in one case that the sale of fertilizers by formula alone in competition with branded goods was not successful. The multiplication of brands, however, especially by the larger companies, has been carried to absurd lengths, partly as a result of the demand for special formulas, but mainly because of the operation of numerous controlled companies, each with its own line of brands. In several States the seven largest companies, including their controlled companies, registered more than one-half of the total number of brands registered. In the State of Vermont out of a total of 185 brands registered in 1914 by all companies The American Agricultural Chemical Co. registered in its own name and through subsidiaries 101 brands. Consequently, the same formula is sold under numerous brand names. In South Carolina, for instance, the Virginia-Carolina Chemical Co., in the season of 1913–14, registered 41 brands of 8–3–3 goods—i. e., 8 units of phosphoric acid, 3 units of ammonia, and 3 units of potash—under its own name and 33 brands of 8–3–3 goods under the names of its controlled companies, making a total of 74 brands of fertilizers of substantially the same composition.

OPERATION OF CONTROLLED COMPANIES AS INDEPENDENTS.

A feature of the mixed-fertilizer business has been the operation by several of the larger companies of various controlled companies as independents. Some of these controlled companies are manufacturers or mixers and others are mere selling companies without any plant. Three of the large companies have acquired an interest ranging from 50 to 100 per cent in numerous local dry mixers in the Southern States.

In some cases the primary purpose of operating controlled companies as independents has been to preserve the value of their names and brands. In most cases, however, the primary purpose has been to secure the services of more dealers in a given locality, for by this means, it is claimed, the credit risks are distributed and the sales increased. The small local concerns acquired have afforded an outlet for surplus acid phosphate and other materials and through the concealment of their identity have secured certain business that the large companies could not obtain because of local prejudice. Several of the largest companies have operated subsidiaries in order to avoid excessive State corporation taxes.

In the opinion of the Commission the particularly objectionable feature of the operation of subsidiary and affiliated companies has been the concealment of the connection of the controlled companies with the parent company. There has been nothing on their letterheads, advertising literature, registration blanks, or containers to indicate that they were not independent. There has also been a manifest effort in some cases to deceive the farmer as to whose fertilizer he was buying. The selling companies have usually advertised themselves as manufacturers, sometimes giving the capacity of their plants when they had none. Several of the controlled companies bear the name "Independent," and one company has incorrectly advertised its selling companies as "Independent Manufacturers of Fertilizers." Furthermore, instances have been found where subsidiaries, especially selling companies, have been used to cut prices, the manufacturers preferring to cut on their weaker lines.

Two large companies, while appreciating the commercial advantages of operating subsidiaries as independents, have refrained from doing it, on the ground that it was an objectionable business practice, and a third company, while operating several subsidiaries, has been careful to identify them and their products. The companies who have engaged in the practice of operating controlled companies as independents have justified it on the ground that it got them additional business, which admission has raised the question whether the practice is not detrimental to competitors who do not do it, as well as to farmers, and hence an unfair method of competition in the sense of section 5 of the Federal Trade Commission act.

For the purpose of considering this question, as well as of devising remedies for the manifest evils resulting from this practice, the Commission has held conferences with various fertilizer companies, as a result of which they have voluntarily agreed to identify their subsidiary and affiliated companies by using some suitable expression, such as "subsidiary of," "branch of," "owned by," "affiliated with," etc., on their letterheads, advertising matter, containers, etc. Some companies made these changes during the spring season and the others agreed to make them by July 1 of this year. It will thus be possible hereafter for State officials, dealers, and, what is perhaps more important, farmers who buy fertilizer to know with whom they are really dealing.

While the adoption of these changes may present some temporary difficulties to the companies making them, in the long run the result can not but be beneficial to the industry and to all connected with it. The Commission believes that these changes will materially aid in restoring healthy competition in the industry and in reducing the number of brands offered for sale. They will also tend to encourage the manufacture and sale of goods of superior quality, since it will no longer be possible to sell a farmer who is dissatisfied the same goods under a different name.

Respectfully submitted.

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REPORT OF THE FEDERAL TRADE COMMISSION ON THE FERTILIZER INDUSTRY.

CHAPTER I.

INTRODUCTION AND SUMMARY.

Section 1. Scope of the report.

This investigation of the fertilizer industry was begun by the Bureau of Corporations pursuant to a resolution of the Senate of the United States[1] and was brought to completion by the Federal Trade Commission, which, upon its organization on March 16, 1915, took over the unfinished work of the Bureau of Corporations. The Senate resolution was as follows:

> *Resolved*, That the Secretary of Commerce and Labor, through the Bureau of Corporations, be, and is hereby, directed to investigate the causes of the advance in price of ammoniates and nitrates used in the manufacture of commercial fertilizers, and report the findings to the Senate at the earliest practicable time.

In complying with the above resolution, wholesale prices of fertilizer materials were collected and studied as being most representative of general market conditions. Phosphates and potash salts were included in the discussion of price fluctuations, since they are also essential elements of commercial fertilizers. The price statistics for the domestic markets were obtained from original sources, such as producers, brokers or importers, and consumers, while those for the foreign markets were obtained from published sources, such as the standard trade periodicals. The tables of wholesale prices and the discussion of the causes of price fluctuations are presented in detail in Chapter VI. A brief summary of the conclusions drawn from this price study is given in the following section of this chapter. In addition to the study of wholesale price fluctuations, some investigation was made of the relation of wholesale prices to the prices paid by the farmer. The facts and conclusions regarding this subject are presented in Chapter VII and summarized briefly in the following section of this chapter.

In connection with this investigation of the prices of fertilizer materials, the Bureau of Corporations and its successor, the Federal

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[1] Senate resolution 487, 62d Cong., 3d sess.

Trade Commission, deemed it essential under the resolution, as well as of public interest, to investigate in some detail the production and sale of the principal fertilizer materials, and also of mixed fertilizers in which the materials are largely used. The facts concerning the production and sale of fertilizer materials are presented in Chapters II to V, inclusive, and the facts concerning the production and sale of mixed fertilizers in Chapter VIII.

Section 2. Conclusions regarding prices.

Wholesale prices of materials.—This report shows that the high prices of sulphate of ammonia and nitrate of soda which prevailed in 1912, the year preceding the passage of the Senate resolution, were due fundamentally to natural conditions of supply and demand, and that the fluctuations in the prices of all the principal nitrates and ammoniates used in commercial fertilizer have been due primarily to the same causes, although artificial conditions, such as combinations of producers, speculation, etc., have at times exerted a temporary influence upon the course of the market. The same conclusions have been reached in respect to the wholesale prices of the principal phosphates, such as phosphate rock, acid phosphate, and basic slag. The wholesale prices of potash salts, on the other hand, are governed by monopoly conditions. Practically all these salts are imported from Germany. The German Potash Syndicate, which handles the entire output of the German potash mines, is able to maintain prices on a purely artificial basis, for the reason that the German Government, by the law of May 25, 1910, has prevented competition among the domestic producers, and competition by foreign producers is insignificant, since no other deposits of potash salts similar in quality and accessibility to those in Germany have as yet been discovered.

Most of the information regarding prices was collected prior to July 1, 1914, so that the above conclusions are applicable to the situation as it existed prior to the outbreak of the European war. During the two years that have passed since July 1, 1914, the war has been the dominant factor in the price situation, causing the prices of most of the fertilizer materials first to fall and then in some cases to rise to extraordinarily high levels.

Retail prices of materials.—In the investigation of retail prices of fertilizer materials it has been found that the prices paid by the farmer often bear little relation to the course of wholesale prices. The statistics given in Chapter VII show that retail prices vary widely in the same season and in the same State, and, in some cases, are unreasonably high in comparison with wholesale prices. This variation in retail prices is due to such factors as the quantity purchased, transportation charges, credit conditions, and profits of middlemen.

It should be noted, however, that of the total tonnage of materials annually consumed for fertilizer not more than 20 per cent reach the farmer in unmixed form. The remaining 80 per cent first pass through the hands of concerns which mix them according to various formulas and sell them to the farmer under brand names. The problem of determining the relation of retail to wholesale prices, therefore, made it necessary to investigate the mixed fertilizer industry.

Retail prices of mixed fertilizers.—The cost of the raw materials as determined by wholesale prices is the principal item of cost to the mixed fertilizer manufacturer and, as such, is a factor affecting the prices charged the farmer. Other important factors are competitive conditions in the industry, the profits of middlemen, credit conditions, etc. Although the identity of the particular materials used in mixed goods is more or less lost, the reasonableness of mixed fertilizer prices can be determined by comparing the price of any formula with the cash value of standard materials containing the same essential elements, making due allowance for the cost of mixing and other necessary costs. Such comparisons show that the prices paid by farmers for various formulas of mixed goods are often noticeably in excess of the cost of the same formulas prepared at home by farmers who buy in important quantities and pay cash for their materials. Investigations by a number of State agricultural experiment stations indicate, however, that the prices of the higher grades of mixed goods are usually more reasonable than the prices of the lower grades.

The European war has resulted in a considerable increase in the prices of mixed goods not only by increasing the cost of materials, particularly potash salts, but also by impairing competitive conditions in the large consuming States of the South, numerous dry mixers having suspended operations.

Section 3. Principal fertilizer materials.

There are three essential elements for a complete fertilizer: (1) Nitrogen, (2) phosphorous, and (3) potassium. Nitrogen influences especially the leaf growth of the plant, phosphorous the fruiting and seed production, while potassium influences especially the formation of starch, sugar, cellulose, etc. Most of the materials used for fertilizing purposes contain one or more of these three elements.

In addition to these three essential elements there are about 10 other chemical elements which are necessary for the normal growth and development of plants. Among these, magnesium, sulphur, sodium, iron, chlorine, silicon, and calcium are the most important. Most of these minor elements are contained in the soil in sufficient quantities.

for the needs of plants and, with the exception of lime, are seldom of sufficient effect on plant growth when added to the soil artificially to justify their inclusion in commercial fertilizers.

Nitrogenous materials.—Of the three essential elements of a complete fertilizer nitrogen is probably the most important as well as the most expensive. Although it exists as a component of the air, forming four-fifths thereof, plants do not have the power of acquiring it from this source directly. Certain legumes, however, such as clover, alfalfa, beans, peas, etc., have associated with them lower organisms which transform atmospheric nitrogen so that it can be absorbed and utilized. All other forms of plant life must obtain their nitrogen entirely from compounds in the soil. Soils become deficient in nitrogen more rapidly than in either of the other two elements, both for the reason that it is consumed in important quantities by plants, and also, as a rule, is lost from the soil to a larger extent through drainage or by escaping into the atmosphere.

The principal high-grade nitrogenous materials used for fertilizer in this country are nitrate of soda, sulphate of ammonia, cyanamid, tankage, blood, fish scrap, and cottonseed meal. Various lower-grade materials are also used. Nitrate of soda, sulphate of ammonia, and cyanamid are inorganic, i. e., mineral substances, while tankage, blood, fish scrap, and cottonseed meal are organic, i. e., derived from animal or vegetable matter. In the fertilizer trade nitrate of soda is classed as a nitrate, and the other nitrogenous materials, whether organic or inorganic, as ammoniates, since they are supposed to give up their nitrogen in the form of ammonia when mixed with the soil. Nitrate of soda and cyanamid are direct products—that is, produced directly for use as fertilizer while the other five materials mentioned above are by-products of unrelated industries. Nitrate of soda is imported entirely from Chile and cyanamid from a manufacturing plant at Niagara Falls, Canada. Sulphate of ammonia is mainly a by-product of coke and gas production in this country and in Europe. Tankage and dried blood are by-products of meat-packing and rendering establishments, the supply being largely domestic. Fish scrap is a by-product obtained in the extraction of oil from menhaden, and also from the waste of the fish-packing industry. The supply of scrap is largely domestic. Cottonseed meal is obtained in the extraction of oil from cotton seed, and is entirely a domestic product.

Phosphates.—Phosphorous is second only to nitrogen as an essential element of plant food which must be supplied to soils. Most soils contain some phosphorous in compound, but these compounds are not usually in a form that can be absorbed by plants. The principal source of phosphorous in commercial fertilizers is acid phosphate, a soluble compound prepared by treating ground phosphate rock with sulphuric acid. Bones are also used as a source of phosphorous in fertilizers. They are usually steamed to remove the grease and other matter and then ground to make them more readily available. In some cases they are treated with sulphuric acid. Basic slag is a third important source of phosphorous. Although not soluble in water, it is not treated to increase its availability. For this reason its action is comparatively slow.

Phosphate rock and acid phosphate are entirely domestic products and are produced directly for fertilizer purposes, while basic slag is a by-product of the basic Bessemer steel process and is imported mainly from Europe. The bones used for fertilizer are obtained as by-products from the slaughtering and rendering industries, both domestic and foreign. Considerable quantities are imported from South America.

Potash.—Potassium is the third essential element supplied by artificial fertilizers. Plants derive their potassium only from soluble potassium salts. Many of the potassium combinations naturally present in the soil are so firmly fixed that they never break up under weathering influences so as to release the potassium. Among the water soluble salts from which potassium can be obtained by plants are potassium chloride (commercially known as muriate of potash), potassium sulphate, potassium nitrate, and potassium carbonate. Only the first two of these are used in an important way as a source of potash for fertilizer purposes, and they are contained in potash salts imported from Germany. Some potassium carbonate derived from wood ashes, however, is still used for fertilizer. This is obtained from domestic sources and also from Canada.

Statistics of consumption.—Great difficulty has been experienced in getting accurate statistics of the consumption of some of the materials for fertilizer purposes. In some cases only estimates can be obtained, for the reason that most of the materials useful for fertilizer purposes also have other uses. Nitrate of soda is used extensively in the manufacture of explosives, and also to some extent in chemical, glass, and dye works, so that, although the total imports are known, the distribution among these different industries is difficult of ascertainment. Likewise, some sulphate of ammonia and potash salts are used by chemical industries. Cottonseed meal is now used more extensively for animal food than for fertilizer, and for the past few years manufacturers have been converting tankage into animal food at a rapidly increasing rate. Fish scrap is also being used to some extent for poultry food.

Table 1 below shows the estimated number of tons of the various materials consumed for fertilizer purposes in 1913, and the units of ammonia, phosphoric acid, and potash which the respective tonnages contain. The basis of these estimates is shown in the following chapters.

TABLE 1.—ESTIMATED CONSUMPTION OF HIGH-GRADE MATERIALS IN COMMERCIAL FERTILIZERS FOR THE YEAR 1913.

Materials.	Fertilizing substance.	Tons consumed.	Content (per cent).	Units consumed.[1]
Nitrogenous materials:				
Nitrate of soda	Ammonia	260,000	18.0	4,680,000
Sulphate of ammonia	do	130,000	25.0	3,250,000
Cyanamid	do	15,488	18.0	278,784
High-grade tankage	do	210,000	10.5	2,205,000
Concentrated tankage	do	18,351	14.5	266,090
Dried blood	do	40,000	17.0	680,000
Dried fish scrap	do	50,000	11.0	550,000
Cottonseed meal	do	660,000	7.5	4,950,000
Total units of ammonia				16,859,874
Acid phosphate	Phosphoric acid	4,000,000	16.0	64,000,000
Potash salts:				
Muriate of potash	Potash (K_2O)	202,342	50.6	10,238,505
Sulphate of potash	do	33,120	47.7	1,579,824
Double manure salts	do	15,221	26.0	395,746
Manure salts (20 per cent)	do	197,071	20.0	3,941,420
Manure salts (30 per cent)	do	11,988	30.0	359,640
Hard salts	do	37,626	16.0	602,016
Kainit	do	445,706	12.4	5,526,754
Total units of potash				22,643,905

[1] A unit is 1 per cent of a ton, or 20 pounds.

Section 4. Fertilizer middlemen.

There are several kinds of middlemen who participate in the distribution of fertilizer materials from the producer to the fertilizer manufacturer, namely, exclusive selling agents, brokers, importers, and jobbers. In a strictly brokerage transaction the broker brings the buyer and seller together, receiving a commission from the latter for his services. Frequently, however, fertilizer brokers act also as importers, jobbers, or exclusive agents, thus combining several of the intermediary activities. There are several brokerage concerns in this country which are branches of foreign houses and conduct largely an import business in fertilizer materials. Most brokers also buy some materials for resale, although this practice is much less common among brokers now than formerly because of the speculative risk incurred.

There are also middlemen, usually retail merchants or local dealers, who are engaged mainly in distributing mixed fertilizers from the manufacturers to the farmers, and a number of concerns that make a speciality of distributing fertilizer materials to merchants and farmers. Fertilizer manufacturers often sell materials and mixed goods directly to farmers as well as through local dealers.

The profits or commissions of these various middlemen, of course, increase the cost of the delivered product and to this extent are a factor in the determination of retail prices.

Exclusive selling agents.—The two principal exclusive selling agents for fertilizer materials in the United States are the German Potash Syndicate, which handles the total output of the German potash mines in all countries, and the American Coal Products Co., which handles about 90 per cent of the total sales of domestic sulphate of ammonia in the United States. Some of the brokerage houses also act as exclusive agents for some particular concern.

The potash syndicate sells directly to a few fertilizer manufacturers on long-term contracts involving the delivery of large quantities of potash salts. It also maintains a distributing agency, with branches in various centers, to handle the direct retail trade in potash salts. Owing to the absence of any competition, the wholesale prices of potash salts fixed by the syndicate are on a purely arbitrary basis.

The American Coal Products Co. is the exclusive agent of almost all of the producers of domestic sulphate by virtue of contracts made with them. It handles their output of sulphate of ammonia on a commission basis, like a broker, and sells mainly to the fertilizer manufacturers. The commissions received by the American Coal Products Co. for acting as selling agent for the domestic producers vary from 2½ per cent to 10 per cent of the net sales, though the brokerage commission usually paid for sales of foreign and domestic material does not exceed 1 per cent. The practical monopoly in the sale of domestic sulphate which this company enjoys does not permit it to control prices, owing to the competition of foreign sulphate of ammonia and other sources of ammonia which are uncontrolled.

An instance of a brokerage concern acting as an exclusive selling agency is The Edward J. Walter Co., of Baltimore, which has an exclusive contract with a large Glasgow house for the sale of foreign sulphate of ammonia in the United States.

Brokers.—The fertilizer broker is the most important of the middlemen connected with the distribution of fertilizer materials. He rarely engages in the sale of mixed fertilizers. In his general operations the fertilizer broker does not differ materially from the broker in other commodities. He acts as a bureau of information and as a sort of clearing house for producers and importers on the one hand and the fertilizer manufacturer on the other. He seldom deals with the farmer. As the fertilizer business is largely seasonal, brokers do not, as a rule, confine themselves to selling materials to the fertilizer trade, but deal also with manufacturers of explosives, chemicals, etc.

The broker makes it a part of his business to keep himself in close touch with his customers and those well informed on market conditions. He circularizes his clients, advising them what materials may be had and at what prices, often expressing his opinion as to whether it would be better to buy or sell now or await expected changes in the market.

The large manufacturers, who have highly organized purchasing departments and buy in large quantities, are often able to secure materials directly at as good, if not more advantageous, terms than through brokers. But few, if any, dispense with brokers' services entirely. The smaller manufacturers, however, are, to a great extent, dependent upon brokers for their supplies, since they have not the time, money, or situation to attempt to keep in touch with the sources of materials and to obtain the lowest quotations thereon.

When a shortage of domestic supply or an advance in American prices or any other cause renders it necessary to turn to the foreign markets the broker is less dispensable to the large fertilizer manufacturer and all the more necessary to the small one, as he has foreign connections with other brokers and keeps in as close touch as possible with conditions abroad.

The customary commissions received by brokers in fertilizer materials are always paid by the seller and vary from 10 cents a ton for phosphate rock and acid phosphate to 1 per cent of the net sales (from 40 to 65 cents per ton) for nitrate of soda and sulphate of ammonia. The commissions on transactions in fish scrap vary from 25 cents per ton to 1½ per cent of the net sales (from 25 to 60 cents per ton for dried fish scrap) and on packing-house fertilizers they are usually 25 cents per ton. Brokers having an exclusive agency or territory or having a special group or line of customers sometimes receive greater or less commissions than those customarily paid.

Importers.—Most of the fertilizer brokers deal in imported as well as in domestic fertilizer materials. There are some concerns, however, which are essentially importers. Frequently they are branches of European houses. Most important among the importers of fertilizer materials are several companies importing nitrate of soda from Chile. The largest of these is W. R. Grace & Co., of New York, which is a domestic corporation with English connections. Another importing concern is Wessel, Duval & Co., a partnership with English connections. These two importers formerly brought in most of the nitrate of soda used for fertilizer, but in 1913 Antony Gibbs & Co., of London, entered the field as an active competitor. The E. I. du Pont de Nemours Powder Co. also imports large quantities of nitrate, but it is used mostly in the manufacture of explosives.

These importers serving the fertilizer trade are unable to control the price of nitrate in the United States, which follows the price in Europe, because the larger purchasers, who have the capital and keep informed regarding market conditions, will purchase cargoes of nitrate in the European or Chilean markets and import them whenever there is any important saving to them in doing so. If the difference in price warrants, cargoes of nitrate may also be diverted to the United States by exporting concerns usually serving the European markets.

Distributing houses.—There are several concerns in the United States which make a business of selling fertilizer materials directly to farmers who desire to do their own mixing. These concerns have offices in various centers located along the Atlantic coast. Their terms are usually cash f. o. b. seaport. They also sell to the small dry mixers at prices which enable them to compete with the larger manufacturers. Thus they exert an important influence upon the prices of mixed goods as well as on the price of fertilizer materials. To the farmer who is able to pay cash for his materials and to purchase in carload quantities these concerns afford an opportunity to save several dollars a ton on his fertilizers. The great majority of farmers, however, are unable to pay cash, and credit conditions are such that generally it is not economical to borrow money with which to purchase materials.

Local dealers.—Mixed fertilizers are sold mainly through retail merchants or local dealers. In the South these concerns usually run a general merchandise store, while in the North they are more often dealers in produce, coal, farm implements, etc. These dealers sometimes sell acid phosphate and other fertilizer materials as well as mixed fertilizers. They are usually supplied with such materials by the fertilizer manufacturers whom they represent.

Local dealers usually purchase their fertilizers on credit. They also sell to the farmer on credit. In the South they frequently take a crop mortgage from the farmer and provide him with all his supplies during the growing season. The prices charged the farmer for the mixed goods as well as materials depend largely upon his credit standing. Where the risk is great the prices are often very high.

Section 5. Fertilizer manufacturers and dry mixers.

Operations.—Mixed fertilizer plants are of two kinds—wet mixers and dry mixers or manipulators. The former are equipped with machinery for grinding phosphate rock and for treating it with sulphuric acid, while the latter are only equipped for mixing the prepared materials in dry form. The wet mixing plants are of two kinds—those equipped with lead chambers for producing their own sulphuric acid, and those that do not have such equipment, but purchase their acid.

There are some 800 fertilizer concerns in the United States, operating about 1,200 plants, of which 256 are wet mixers and the rest dry mixers. Among these fertilizer manufacturers are several large concerns such as the Virginia-Carolina Chemical Co., The American Agricultural Chemical Co., International Agricultural Corporation, and Armour Fertilizer Works, which have numerous plants scattered over the country. Various operations are carried on by these concerns. They mine and sell phosphate rock, manufacture sulphuric acid and acid phosphate, and mix and sell fertilizers. In a few cases they also are engaged in the production of other fertilizer materials, such as tankage and dried blood, cottonseed meal, and sulphate of ammonia.

The preparation of mixed fertilizers, as distinguished from the production of fertilizer materials, consists mainly in the mixing. In this operation the large wet mixing plants perform exactly the same work as the dry mixing plant or the home mixer. The process of mixing fertilizers is not secret or difficult to learn, and is, therefore, no deterrent to the growth of competition. The mixing machines used by fertilizer plants are also comparatively inexpensive. The farmer can mix economically, using only a screen and a shovel. Thus, as far as equipment is concerned, it is possible to engage in the mixed fertilizer business with comparatively small capital.

Selling methods.—Small fertilizer concerns usually sell directly to the farmer, while the larger concerns distribute mainly through local dealers or agents, although direct sales to farmers by the larger concerns are increasing in certain localities. The competition among fertilizer companies manifests itself particularly in the efforts of the larger concerns to place lines of goods with as many of the local dealers in each town as possible, not only for the purpose of increasing their sales but also to distribute their credit risks. This is accomplished by organizing and acquiring subsidiaries which are often operated as independents. Each subsidiary concern has its own line of fertilizers and endeavors to secure a dealer in each town as a representative. In this way a large concern may be able to secure the services of several or all of the dealers in a town without having two dealers selling the same line of goods, which could not be done if the company were operating entirely under its own name. Some of these subsidiaries are pure selling companies, although they advertise as manufacturers. The American Agricultural Chemical Co. has been most conspicuous in operating such companies. At present it has no less than 17 of them doing business in a large number of States.

Control of dry mixers.—Three of the large fertilizer companies have adopted the policy of organizing or acquiring an interest in local dry-mixing concerns which are operated as independents. One purpose appears to be to afford an outlet for surplus acid phosphate and another to retain or to give them a local character. In 1914 the Virginia-Carolina Chemical Co. had 21 affiliated dry-mixing concerns and the International Agricultural Corporation had 43. The Armour Fertilizer Works and two of its subsidiaries held through intermediaries the capital stock of 12 local fertilizer concerns operating 13 dry-mixing plants and 2 wet-mixing plants. Eleven of these plants were located in Georgia.

Most of the larger concerns have also established dry-mixing plants under their own names or those of their subsidiaries. For instance, in 1914 the Virginia-Carolina Chemical Co. proper had 7 dry-mixing plants, its subsidiaries 57 plants, which with the 30 plants operated by affiliated companies, made a total of 94 dry-mixing plants located in 10 different States. The International Agricultural Corporation had some 45 dry-mixing plants located in 7 States and Canada.

Identification of subsidiaries.—The Commission, after investigating the practice of operating subsidiary and affiliated companies as independents, was of the opinion that it was an objectionable one. When this attitude of the Commission was made known to the large fertilizer concerns practically all of them voluntarily agreed to identify their controlled companies by using suitable phraseology on their letterheads, advertising matter, bags, etc. It will thus be possible hereafter for the dealer and the farmer to know exactly with whom they are doing business. Details regarding this matter are discussed elsewhere. (See Chap. VIII.)

Multiplication of brands.—In the original organization and during the earlier years of the large fertilizer concerns a considerable number of independents were taken over and merged with the parent companies and the popular brands of these merged companies were largely retained. By subsequently organizing and acquiring numerous subsidiaries, each with its own set of brands, the number of brands offered for sale by a given concern has been further multiplied, so that as a result we have the anomaly of a single corporation with its subsidiary and affiliated concerns registering in a certain State a thousand brands of mixed fertilizers and more than 70 brands of a particular formula. The existence of such a large number of brands imposes heavy burdens upon the State officials, who are charged with the duty of analyzing them to ascertain whether they contain the guaranteed amount of plant food. This fact has led a number of States to impose a brand tax upon all registrations in order to reduce the number. The imposition of such a tax in New York State resulted in a decrease of 50 per cent in the number of brands registered.

Costs and profits.—Materials form the principal item of cost in the mixed fertilizer industry. For the small dry mixer who sells directly to the farmer it probably amounts to more than 90 per cent of his total cost, while to the farmer who does his own mixing it is his total cost, except about 50 cents a ton for labor. On the other hand, the large fertilizer concerns which sell over an extensive territory have various distributing costs, such as outgoing freight, advertising, salaries and commissions of salesmen, etc., so that the cost of materials represents about 75 per cent of the total operating costs.

In recent years independent dry mixers ~~have been~~ are able to purchase their materials at prices but little above the cost of materials to the large concerns. For this reason they ~~have been~~ able to compete successfully with the large concerns within their respective localities, so that while the gross sales of the large concerns increased rapidly from 1910 to 1914, inclusive, the cost of materials and selling expenses also increased, and prices and the rate of profit upon investment declined.

The principal advantages of the large concerns lie in their facilities for furnishing credit on an extensive scale and in doing business over such a wide territory that unprofitable conditions in one locality are offset by profitable conditions elsewhere. The operation of subsidiaries as independent concerns has also given them some advantage in obtaining local dealers as agents.

Section 6. State fertilizer-control laws.

Regulations.—All but 11 States have enacted laws regulating the manufacture and sale of commercial fertilizers and prescribing penalties for their enforcement. The 11 States not having fertilizer laws are Minnesota, South Dakota, Nebraska, Montana, Idaho, Wyoming, Nevada, Utah, Colorado, Arizona, and New Mexico. The total consumption of these States is about one-fourth of 1 per cent of the total for the United States. The laws of the States which have enacted fertilizer laws vary in most of the provisions, but are nearly uniform in requiring that brands offered for sale be registered, and that printed statements containing certain facts regarding them be attached to each package of fertilizer. The certificates of registration are required to be filed annually, showing the brand or trade name, name and address of the manufacturer, guaranteed analysis, and sources of nitrogen, phosphoric acid, and potash. The printed statements attached to each package are required to show the name, brand, or trade-mark under which it is sold, name and address of the manufacturer (in some cases, place of manufacture), the net weight, and guaranteed analysis, which must show in minimum percentages the quantities of available nitrogen or ammonia, potash soluble in water, and the total available phosphoric acid. Some of the States require that the water soluble and citric soluble, or reverted phosphoric acid, shall be given as well as the total available, which is the sum of the two, and also the insoluble phosphoric acid. A few of the States require that the sources of the plant-food ingredients must be stated on the tag or printed statement attached to the package. Several of the States prohibit the sale of leather or its products, hair, hoofs, horns, or wool waste in any form as a fertilizer material, unless a full and explicit statement of the fact is made at the time of registration and satisfactory proof furnished as to the availability of the nitrogen content.

A number of the Southern States classify the various brands of fertilizers into several grades. Thus, in Alabama no complete fertilizer, alkaline goods, or acid phosphate, shall be sold which contains less than 14 per cent of plant food, and no complete fertilizer shall contain less than 1.65 per cent of nitrogen (2 per cent ammonia). Georgia provides that the minimum content of plant food in "high grade" fertilizers shall not be less than 14 per cent, and in "standard grade" not less than 12 per cent. South Carolina provides that "high grade" fertilizers shall contain at least 13 per cent of plant food, "standard grade" at least 12 per cent, and that any complete fertilizer, containing less than 12 per cent, shall be classed as low grade. Viriginia fixes the minimum percentage of plant food in complete fertilizer, acid phosphate with potash or plain acid phosphate, at 11 per cent, whether of a single element or of a combination of elements.

Most States allow a certain deficiency in the guaranteed amount of plant food in commercial fertilizers without penalizing the manufacturer. The maximum deficiency thus allowed varies widely in the different States. In Indiana no deficiency is allowed, while in other States it ranges from 3 to 20 per cent. The penalties imposed also range from the commercial value of the deficiency to the value of the goods so found to be deficient in guarantee. There are usually compensating provisions, for example, that an excess in one ingredient will offset a deficiency in another. In Indiana, however, the law specifically states that an excess of one ingredient can not compensate a deficiency in another, and provides a penalty of $50 for first offense and $100 for each subsequent offense.

Analysis of fertilizers.—The State agricultural departments or certain officials connected therewith, or State experiment stations, and agricultural colleges are usually empowered to prescribe and enforce rules and regulations deemed necessary to carry into effect the provisions of the fertilizer laws. The officials charged with the administration of the fertilizer laws are also required to publish from time to time the results of analyses of samples of fertilizers taken from goods sold within the State, and of experiments made with fertilizers at the stations and colleges. These reports often contain, in addition to the results of tests and experiments, valuable suggestions to the farmer concerning the value of commercial fertilizers and fertilizer materials, and how to use them.

In order to secure uniformity and accuracy in the methods of analyzing fertilizers, the officials charged with determining the availability of the plant-food content of fertilizer materials and mixed fertilizers have adopted certain tests which although arbitrary serve the purpose of protecting farmers against the purchase of low-grade fertilizers. Organic ammoniates are usually tested with an alkaline or neutral permanganate solution and acid phosphate with a weak ammonium citrate solution, while potash salts are tested with pure distilled water.

Fertilizer taxes.—All the States which have enacted fertilizer-control laws impose some sort of tax or fee on the commercial fertilizers sold within the particular State. These taxes are classed as brand, inspection, tonnage, registration, and license taxes or fees. While most of the States impose only one fertilizer tax, several have two taxes and one has three. The tag tax ranges from 10 cents per ton in Georgia to 50 cents in Kentucky and Tennessee, while the registration or brand tax ranges from $5 for each ingredient in each brand in some of the New England States to $10 per brand in Maryland, $30 in Ohio, and $50 in California.[1]

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[1] All of the States south of the Potomac and Ohio Rivers impose a tonnage tax, while all but two of those north impose a tax on brands. Four of the States west of the Mississippi have a tonnage tax, five a brand or registration tax, and one has both. Five other States have both a brand and tonnage tax. Eleven States have no fertilizer law. In the following tabulation are indicated the kinds of fertilizer taxes and amount of tax per ton or brand imposed by the States having laws governing the sale of fertilizers and fertilizer materials:

State.	Tax.		Remarks.
	Tonnage.	Brand, license or registration fee.	
SOUTHERN.			
Virginia	$0.15	$5.00	
North Carolina	.20		
South Carolina	.25		
Georgia	.10		
Florida	.25		
Alabama	.30	5.00	Also a general license fee of $1 from every person dealing in fertilizer.
Mississippi	.20	5.00	
Louisiana	.25		
Kentucky	.50		
Tennessee	.50		
West Virginia	.40	1.00	
NORTHERN.			
Maine		5.00–10.00	$10 for nitrogen and phosphoric acid, and $5 for potash in each brand.
New Hampshire		5.00–10.00	$5 for nitrogen and potash, and $10 for phosphoric acid. Maximum fee for a brand, $15.
Vermont		20.00	
Massachusetts		8.00	$8 for each ingredient in each brand.
Rhode Island		8.00	Do.
Connecticut		10.00	$10 for each ingredient in each brand.
New York		20.00	
New Jersey	.15		
Pennsylvania		15.00–30.00	100 tons or less, $15; 100–500 tons, $20; 500 or over, $30.
Maryland	.10	10.00	
Delaware		20.00	
Ohio		30.00	
Michigan		20.00	
Indiana	.10		Minimum.
Illinois		20.00	
Wisconsin		25.00	
WESTERN.			
Missouri	.30		
Arkansas	.25		
Kansas	.25		
Texas	.25		
California	.25	50.00	
Iowa		20.00	
North Dakota		20.00	
Oklahoma		20.00	
Washington		6.00	$6 for each ingredient in each brand.
Oregon		20.00	

From these fertilizer taxes a considerable amount of revenue is derived, and they are a factor in the prices of fertilizers. The fertilizer-tax receipts for the fiscal year 1914 amounted to $261,120 for South Carolina, $177,660 for Alabama, $174,565 for North Carolina, and $143,038 for Georgia, making a total of $756,383 for the four States. The receipts for South Carolina and Georgia include cottonseed meal. New York receipts in 1913 from fertilizer brand licenses were $37,005 and Pennsylvania receipts $30,545. The total amount of tag taxes paid on fertilizer sales in 1913 is estimated at more than $1,000,000, and the brand license and analysis fees probably amounted to $250,000 additional, making a total revenue derived of at least $1,250,000.

Section 7. Summary of conclusions.

The investigation of the fertilizer industry shows that the price movements of materials, except potash salts, are controlled fundamentally by conditions of supply and demand. The prices of nitrate of soda and sulphate of ammonia are considerably influenced by conditions in the European beet-sugar industry, while the prices of the organic ammoniates are affected largely by domestic crop conditions. Cottonseed meal prices usually follow the trend of corn prices and influence the course of prices of the other organic ammoniates, tankage, dried blood, and fish scrap. As a result of these factors the trend of prices of the inorganic and the organic nitrogenous materials show little relation to each other. The prices of nitrate of soda and sulphate of ammonia have been high at times when the prices of tankage and cottonseed meal were low, and vice versa.

Conditions of supply and demand also, in the main, control the prices of mixed fertilizers. Overproduction and the seasonal nature of the fertilizer trade result in sharp price cutting to unload stocks, especially in years of slackening demand. Few of the fertilizer concerns have an adequate system of cost accounting, so that the restraining influence which comes from knowing the actual cost of production is little felt in the trade. The comparatively unsatisfactory condition of the mixed-fertilizer business in recent years has been manifested by the efforts of some of the large companies to secure control of local dry mixers and also to monopolize local dealers, the latter desire being responsible for the operation of controlled companies as independent manufacturers and the multiplication of brands beyond all reason.

An important feature of the fertilizer industry in recent years has been the rapid increase of local dry-mixing concerns, especially in the cotton-growing States, and the activities of concerns engaged in selling fertilizer materials and in spreading a propaganda for home mixing. The competition of these concerns has had an important effect on the mixed fertilizer business. In some localities, particularly in Georgia, the local dry mixers have driven the local dealers out of business and forced the larger concerns to sell directly to farmers. In other localities home mixing has made substantial inroads into the sale of mixed fertilizers. The great advantage of dry mixers as well as home mixers has been that they could buy their materials at prices but little above those paid by the larger fertilizer manufacturers, while they were free from the numerous and increasing distributing expenses of the latter. The low prices at which dry mixers have obtained bulk acid phosphate were due to the competition of the larger manufacturers in disposing of their surplus stocks. By throwing large quantities of this material on the market at prices sometimes below the actual cost of production they have furnished their competitors one means of competing successfully against them.

The high costs of distribution of the large fertilizer manufacturers are due not only to increasing competition but also to the unsatisfactory condition of agricultural credits. The great majority of farmers, especially in the important fertilizer-consuming States, do not have the cash with which to purchase their fertilizers and often they can not borrow money at all or only at excessive rates. Hence, in order to sell their goods, it has been necessary for fertilizer manufacturers to extend credit to their customers—in other words, to wait for their pay until the crops on which the fertilizers are used have been harvested. In furnishing such credits the fertilizer manufacturers have not only benefited themselves but by making possible the increased use of fertilizers have benefited the communities in which they do business. The extension of credits, however, has made it necessary either to establish expensive credit organizations, especially where direct sales have become important, or to sustain considerable losses from bad debts.

Largely as a result of unsatisfactory credit conditions, the prices paid for fertilizer materials and mixed goods by the great majority of farmers who buy on credit are frequently excessive as compared with the cash value of the fertilizers purchased. Instances have been found where farmers have paid double the wholesale price for their fertilizer materials and nearly double the cash value of the constituent materials for their mixed fertilizers. The credit system is also responsible in part for the practice of operating subsidiaries as independents, for by so doing the manufacturers secure more dealers as representatives in a given locality and thus distribute the risks of doing business. In view of these facts the present extremely unsatisfactory credit conditions should be made the subject of a special study with the view of relieving the farmer of the heavy interest burden especially on personal credits and at the same time assuring greater safety to creditors.

CHAPTER II.

PRODUCTION AND SALE OF INORGANIC NITRATES AND AMMONIATES.

Section 1. Introduction.

This chapter deals with the production and sale of nitrate of soda, cyanamid, nitrate of lime, and sulphate of ammonia, these being the principal inorganic materials used as a source of nitrogen in fertilizers.

Nitrate of soda is produced in Chile by refining a mineral known as caliche and is imported into this country for fertilizer and other purposes. Cyanamid and nitrate of lime are obtained by extracting the nitrogen from the air by electrical process. They are not produced commercially in the United States. Sulphate of ammonia is chiefly a by-product from the manufacture of coke in by-product ovens. The domestic production of this material is increasing rapidly, but in 1913 it supplied only about 59 per cent of the domestic consumption.

Section 2. Nitrate of soda.

Nitrate of soda in its pure form is a grayish white salt readily soluble in water.[1] The commercial product used for fertilizing purposes contains 95 per cent of nitrate of soda and sometimes has a brown or pink color, depending upon the character of the impurities, the most important of which is sodium chloride.

Commercial nitrate contains 15.65 per cent of nitrogen, which is equivalent to about 19 per cent of ammonia. The nitrogen contained in nitrate of soda is generally spoken of as nitrate nitrogen, which is the form most readily assimilated by plants. Nitrate of soda is especially effective as a top dressing for certain kinds of crops, such as sugar beets and cotton, citrus fruits, etc. The principal disadvantage of nitrate of soda is that it is easily leached from the soil if a heavy rain occurs before it has been taken up by vegetation. The nitrate also has a tendency to absorb moisture, causing it to become lumpy and difficult to spread or mix properly.

Sources of nitrate of soda.—The only known natural deposits of nitrate which are of commercial value are located in the rainless regions of northern Chile. Scattered deposits of low-grade nitrate have been found in the caves of Kentucky and in some Western States, especially in southern California. Similar deposits have also been found in Egypt. In the regions of Peru and Bolivia adjacent to Chile, deposits have recently been discovered which may also prove to be of commercial value.

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[1] The chemical formula is $NaNO_3$.

Nitrate of soda can now be obtained by electrical process from the air, but the quantity manufactured in this way is insignificant in comparison with the quantity obtained from the natural deposits, and the process too expensive to permit of the use of the material for fertilizer, although the electricial process affords an economical means of obtaining several other nitrogenous fertilizers. (See p. 32.)

Chilean nitrate deposits.—The principal deposits of nitrate in Chile are found in the pampas of Tarapaca and Antofagasta. There are also deposits in the Provinces of Toco, Aguas Blancas, and Taltal. The nitrate region embraces a zone lying between 18° and 27° south latitude, which is about 500 miles in length from north to south, located on the eastern slope of the first range of mountains or Cordilleras. The beds are found at distances from the coast varying from 20 to 100 miles, and at altitudes of from 4,000 to 12,000 feet above sea level.

The caliche, as the unrefined salt is called, is found mainly in deposits covered with strata of other salts, ranging from a few inches to 20 feet or more in depth. A small portion of the quantity mined is found in the form of impregnations in the surface decomposition of broken rocks.

The caliche deposits are generally covered by two strata. The uppermost, called the chuca, consists of a loose mass which breaks up easily or is already pulverized. The second layer called the costra, is a conglomerate mixture of sodium and other salts, varying in depth from 1 foot to 20 feet. Some beds of costra contain a sufficient proportion of sodium nitrate to be workable.

Below the costra is a stratum of caliche usually from 16 to 32 inches in thickness. This is also a conglomerate mixture of various sodium, potassium, and magnesium salts in varying proportions. Nitrate of soda forms as low as 7 per cent of the total in the poorest deposits and as high as 30 to 50 per cent in the richest deposits, the medium qualities containing from 30 to 40 per cent and the best grades containing from 40 to 50 per cent. For commercial purposes only the deposits averaging above 12 or 15 per cent are now utilized.

Process of mining and refining.—The usual method of extracting the caliche is to open up a trench by drilling a series of holes through the several strata to the clay stratum beneath the caliche and blasting them out. The caliche, which is blown up in large chunks, is separated from the other strata and loaded into carts or small cars by which it is conveyed to the refining plant.

Upon reaching the refinery the caliche is broken up into small chunks in a crusher, dumped into the vats, and the nitrate lixiviated or leached out with boiling water. The boiling usually continues from 20 to 24 hours, according to the quality of caliche treated. After boiling the solution is concentrated and clarified and then run off into crystallizing tanks, where it is allowed to stand for several days. When sufficiently dry the crystals are thrown upon the stock pile, where the sun and wind complete the process of drying. Finally, the nitrate is put into sacks weighing 100 kilograms (about 221 pounds) and loaded into cars for shipment to the seaports.

Cost of producing nitrate.—In 1903 two German engineers made a detailed investigation of the cost of producing, refining, and shipping nitrate of soda. Their estimates of the maximum, minimum, and average cost by items for nitrate loaded on shipboard in the various Chilean seaports is shown by the following table:

TABLE 2.—MAXIMUM, MINIMUM, AND AVERAGE COST OF NITRATE OF SODA IN CHILE IN 1903.[1]

[Per 100 pounds.]

Item.	Maximum.	Per cent of total.	Minimum.	Per cent of total.	Average.	Per cent of total.
Cost of mining	$0.59	37.11	$0.08	9.09	$0.25	21.55
Cost of refining	.21	13.21	.11	12.50	.16	13.79
General expenses	.05	3.14	.03	3.41	.04	3.45
Total	.85	53.46	.22	25.00	.45	38.79
Profits from company stores	.02	1.26	.03	3.41	.02	1.72
Net cost per 100 pounds on stock pile	.83	52.20	.19	21.59	.43	37.07
Sacks, cord, sacking and loading	.04	2.51	.04	4.55	.04	3.45
Railroad freight	.11	6.92	.07	7.95	.09	7.76
Port expenses	.02	1.26	.02	2.27	.02	1.72
Export tax	.56	35.22	.56	63.64	.56	48.28
Commissions	.03	1.89	....	....	.02	1.72
Total	.76	47.80	.69	78.41	.73	62.93
Total cost per 100 pounds alongside vessel	1.59	100.00	.88	100.00	1.16	100.00

[1] Compiled from La Industria del Salitre en Chile by Semper and Michels (Berlin, 1904), translated into Spanish and enlarged by Gandarilla and Salas, Santiago de Chile, 1908, p. 94–110.

The greatest variation between the maximum and minimum costs occurs in the first two items. The minimum cost of mining and refining caliche is based on the highest grade of raw material and the best equipment. The maximum cost is based upon the lowest grade of caliche and the poorest equipment. Both estimates are, therefore, theoretical extremes, not existing in actual operation, for no oficina[1] combines all the factors necessary to obtain the minimum cost, and none having the maximum cost of production could operate. The average cost of nitrate of $1.16 per 100 pounds alongside vessel, given in the last column of the table, is a fairly accurate approximation to the cost figures attained by a majority of oficinas in operation at that time. Since 1903 the cost of mining and refining caliche has increased to a considerable degree in all oficinas, while the other costs have remained stationary or increased but slightly. In 1908 the cost of production of nitrate of soda was estimated to range from $1.34 to $1.58 per 100 pounds, while in 1914 it cost many plants as much as $1.67 per 100 pounds to produce nitrate and pay the export tax of 56 cents.

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[1] The name given to the nitrate works.

In a communication read before the Eighth International Congress of Applied Chemistry, in September, 1912, Prof. Belisario Diaz Ossa, of Chile, stated that a pound of nitrogen in sodium nitrate put on board ship in sacks on the Chilean coast cost at least 7.7 cents, and on the average 8.8 cents, which is equivalent to $1.36 per 100 pounds of nitrate, as compared with the average cost in 1903 of $1.16 per 100 pounds. This cost figure is distributed by him thus:

	Per cent.
Export duty	41
Supplies (sacks, oil, fodder, powder, etc.)	6
Freight, lighterage, and commissions	11
Administration and general expense	3
Labor	19
Coal	11
Amortization	9

The cost of a pound of nitrogen carried to Europe he estimated to be at least 11 cents, and on the average about 13 cents, which is equivalent to $2.02 per 100 pounds of nitrate.

According to another leading authority the cost of nitrate 10 years ago scarcely exceeded $1.20 per 100 pounds alongside vessel, including the export tax, whereas at the present time the corresponding cost for various oficinas is more than $1.64 per 100 pounds.[1] The crisis which arose in the industry in 1898–99 was caused by a decline in the price alongside vessel to $0.99 per 100 pounds, while in 1913, as a result of the increase in cost of production, a crisis arose with the price between $1.68 and $1.92 per 100 pounds.

The increase in the cost of mining and refining nitrate has been due mainly to the marked advance in wages and in the cost of fuel and to the steady decline in the quality of the caliche mined. Since the strike of the laborers in 1908, wages have been nearly doubled, and the cost of manufacturing nitrate has been increased about 40 per cent. The demand for labor in Chile has been greatly increased by the extensive railroad building and the opening up of copper mines during the last decade. The introduction of Chinese and Negro labor into the nitrate industry has not proved successful. As a result of the steady decline in the quality of caliche mined, it has been estimated that a workman produces 30 per cent less nitrate to-day than was the case 30 years ago, even with the aid of improved machinery and processes. Oficinas which mine inferior caliche must, therefore, employ more labor and extract more material in order to produce the same quantity of nitrate. In 1901 the average quality of caliche worked was 28 per cent. By 1909 it had declined to below 19 per cent, and in 1913 was stated to be about 18 per cent.

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[1] Alejandro Bertrand, The World Market for Nitrogen in 1913; Quarterly Circular No. 62 of the Nitrate Propaganda Association, p. 274.

In refining caliche coal is used in large quantities. The increase in the price of coal has greatly enhanced the cost of refining. In 1903 both foreign and native coal in Chile cost only $4.75 per ton, while in 1912 the price of the latter had advanced to $7.30 and of the former to $9.50. In recent years, however, this increase has been offset in part by the use of oil in some oficinas. In some cases the substitution has reduced the fuel cost as much as 40 per cent. The oil, however, is taken to Chile in tank steamers, which are unable to carry nitrate as a return cargo, as did the coal-carrying sailing vessels and colliers which they displaced, and this has tended to some extent to raise freights on nitrate. The Government of Chile is now engaged in experiments to discover a cheaper method of refining.

Another item of cost which has increased greatly of late is the price demanded by the Chilean Government for new lands. The nitrate companies have paid the following amounts per Spanish quintal (101.46 pounds) of exploitable nitrate from 1880 to 1912, inclusive: In 1880, from 3 to 4 cents; until 1889, from 4 to 7 cents; in 1901 and in 1903, from 5 to 10 cents; in 1912 (minimum), 24 cents.

Growth of nitrate industry.—The first shipments of nitrate from the deposits in South America occurred in 1830, but it was not until after the close of the war of Peru and Bolivia against Chile, 1879–1881, that exports of nitrate became important. As a result of this war the nitrate fields formerly owned by Peru and Bolivia came into the possession of Chile, and since that date the Chilean Government has been vitally interested in the industry. It furnishes the principal source of revenue for the Chilean treasury. Since 1880 a tax amounting to $11.19 per net ton (2s. 4d. per Spanish quintal) has been levied on all exports of nitrate of soda. In 1913 it yielded more than $32,000,000. In addition, the Chilean Government derives an income from the sale of its lands. At certain periods auctions are held by a special legislative act, the quantity and quality of the nitrate contained in the lands to be sold having been appraised by the Chilean Government and the minimum price per quintal fixed. To prospect and survey its nitrate fields the Government has established a board known as La Delegacion Fiscal de Salitreras, or fiscal commission of nitrate lands. The Government also contributes liberally to a propaganda fund to encourage consumption, and has an agent stationed in Europe to keep it informed of the market conditions and the results of the propaganda in these markets.

English capitalists were the first to exploit the Chilean nitrate fields. They were followed by the German and other foreign interests. In recent years Chilean capitalists have come into prominence and a movement has been started to nationalize the industry. In 1895 Chilean oficinas furnished less than 13 per cent of the total exports, whereas in 1912 they furnished 38.5 per cent. Table 3 shows the percentages of the total exports of nitrate produced by interests of different nationalities in various years.

TABLE 3.—PERCENTAGES OF THE TOTAL EXPORTS OF CHILEAN NITRATE PRODUCED BY INTERESTS OF DIFFERENT NATIONALITIES IN VARIOUS YEARS FROM 1895 TO 1912.[1]

Interest.	1895	1897	1907	1911	1912
Chilean	12.75	15.625	21.0	31.02	38.53
English	59.625	42.375	40.686	25.07	36.95
German	8.125	13.125	19.799	23.79	15.10
Spanish	5.25	9.625	7.518	4.49	1.44
Peruvian	8.25	5.75	5.153	4.17	2.56
Austrian	0.	.75	2.058	4.17	1.88
French	2.0	8.375	.736	3.94	.43
Italian	4.0	4.375	3.05	3.35	2.83
American	0.	0.	0.	0.	.28
Total	100.00	100.00	100.00	100.00	100.00

[1] Compiled from La Provincia de Tarapaca by Fernando Lopez Loayzo, pp. 70–72.

The progress of the nitrate industry during the last decade is shown by Table 4, compiled from statistics published by the Nitrate Propaganda Association. It will be seen that production has increased from 1,718,559 tons of 2,000 pounds in 1904 to 3,055,808 tons in 1913, or an increase of 77 per cent. During the same period consumption has increased from 1,661,026 tons to 2,817,282 tons, or an increase of 70 per cent. Although in some years the increase in production, exportation, and consumption has been slight, there is no year during this period, except 1907, when there was any decrease, and this occurred only in the exports. The year 1912 was the only year during this period in which the visible supply in the world's markets decreased.

TABLE 4.—STATISTICS OF THE CHILEAN NITRATE INDUSTRY, 1904–1913.[1]

Year.	Production.	Exportation.	Consumption.	Visible supply in various markets on Dec. 31.
	Net tons.	*Net tons.*	*Net tons.*	*Net tons.*
1904	1,718,559	1,653,634	1,661,026	1,164,556
1905	1,934,070	1,819,167	1,803,487	1,305,741
1906	2,008,518	1,904,706	1,907,060	1,403,375
1907	2,034,853	1,825,473	1,916,517	1,524,127
1908	2,172,571	2,260,716	2,024,321	1,657,868
1909	2,326,875	2,353,327	2,255,497	1,703,876
1910	2,717,584	2,574,867	2,601,004	1,796,119
1911	2,778,880	2,700,058	2,645,862	1,867,046
1912	2,850,338	2,748,081	2,788,273	1,784,983
1913	3,055,808	3,018,424	2,817,282	1,925,357

[1] Compiled from quarterly circulars of the Nitrate Propaganda Association (Asociación Salitrera de Propaganda).

Nitrate companies.—There were in 1913 about 77 nitrate companies in Chile which together operated 128 oficinas, with several idle and others under construction. The only American company engaged in the mining of caliche is the Du Pont Nitrate Co., a subsidiary of E. I. du Pont de Nemours Powder Co., Wilmington, Del., which has two oficinas, one of which was in operation in 1913. However, there is considerable American capital invested in the securities of various nitrate companies.

The capitalization of companies owning the nitrate oficinas and railroads was estimated in 1909 by a prominent Chilean Government official at approximately $134,000,000.[1] This same authority places the actual value of the properties at less than $30,000,000, the difference being overcapitalization. Most of the companies now producing nitrate have been formed since 1900. In most cases they were capitalized on the basis of the prosperous years preceding 1907. As a result it is stated that some of the new concerns, especially those organized during the nitrate boom, have a capital stock amounting to six times the actual investment.

Combinations of nitrate producers.—Since the war with Peru in 1879–80 the production of nitrate in Chile has shown an almost constant tendency to outstrip consumption. In an effort to control this situation the producers at different times have entered into agreements to restrict output. The last combination expired in January, 1914. The periods covered by these combinations are as follows:

First combination, from June, 1884, to December 31, 1886.
Second combination, from January 1, 1891, to March 31, 1894.
Third combination, from January 1, 1896, to October 1, 1897.
Fourth combination, from April 1, 1901, to March 31, 1906.
Fifth combination, from April 1, 1906, to March 31, 1909.
Sixth combination, from August 31, 1913, to January 31, 1914.

The essential features of these combination agreements were as follows: (1) The total exportation of nitrate of soda during each year was agreed upon; (2) initial quotas for each producer were fixed at the beginning of each combination and the actual quotas each year determined by taking a certain per cent of the initial quotas. This percentage figure was the proportion of the aggregate initial quotas represented by the total quantity agreed upon for export, making due allowance for the quantity to be produced by new mines, etc.; (3) if a member produced a quantity 15 per cent in excess of his allotment for exportation he incurred a heavy penalty. Furthermore, the 15 per cent excess production could not be exported during the year, but must be computed as a part of the quota for the following year; (4) if a member exported a quantity in excess of his allotment he paid a heavy penalty for the excess; (5) an oficina must produce its full quota during the nitrate year or lose its right to produce its full quota during the following year; (6) if an oficina did not export its whole quota during the year it could ship the balance in the following year, provided that it was produced during the preceding year; (7) provision was made for the admission of new oficinas. Their allotments reduced the quotas of those already in the combination; (8) an owner of several oficinas was allowed to apportion his total allotment among them as he chose.

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[1] Alejandro Bertrand, La Crisis Salitrera, Paris, 1910.

These combinations apparently were not able to exert a controlling influence upon the price of nitrate, except for short periods of time.[1] They never succeeded in including all the oficinas and never undertook to regulate the distribution of their output. After the formation of the first combination prices turned upward for about a year, when a reaction occurred and prices declined, until at the expiration of the combination, on December 31, 1886, they were at the lowest point, with one exception, that they have ever reached.

After the formation of the second combination prices again rose for a time, but it is probable that the Chilean revolution of 1891, which greatly checked production, had more influence on the upward course than the combination.

The third combination broke up at the end of about 20 months on account of discord among the members. During this time prices declined almost continuously. Soon after the breaking up of the combination they began to rise.

The fourth and fifth combinations covered a period of eight years. During the first five years the course of prices was mainly upward. During the remaining three years the trend was downward. Efforts to renew the combination which expired in 1909 were unsuccessful. From April, 1909, to August, 1913, there was no combination, but during this time prices rose to the highest point ever reached and then turned downward, beginning about March, 1913. By August, 1913, prices had declined to about the 1909 level.

After the formation of the sixth combination, in August, 1913, there was a slight improvement in prices, but only for a few weeks. The decline then continued, prices reaching the low point in November.

The plan of organizing a selling syndicate, such as exists in the German potash industry, has been strongly urged for the nitrate industry, it being held that it was unwise simply to control the output and leave the distribution to the mercy of speculators. In 1899, two years after the collapse of the third combination, the English concerns, which almost monopolized the nitrate trade at that time, attempted to create a sales syndicate, composed of all producers, with Antony Gibbs & Co. at the head of a committee which was to fix the annual production, date of export of each cargo, port of destination, and the price. Apparently the only reason for the failure of the plan was the resistance manifested by the non-English concerns. Again, in 1903, Antony Gibbs & Co. proposed to the nitrate producers the centralization of sales by means of an assignment to them of the entire output, but the proposition was not accepted.

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[1] cf. Bertrand, op. cit. Chap. I.

It has been suggested that if the distribution of nitrate were placed in the hands of the Chilean Government the exporters and commission men between the producer and the consumer would be eliminated and sharp fluctuations in prices obviated, and that with the stability of prices thus assured dealers would be able to carry supplies without incurring the risk now caused by fluctuating prices. It is argued that if such a policy were adopted the consumer would get his nitrate cheaper and the producer would get a better price.

Nitrate propaganda.—After the termination of the first combination in 1886 the producers of nitrate formed an association for the promotion of a propaganda throughout the principal agricultural countries. In 1894 the Nitrate Propaganda Association was formed as a successor to the earlier association. Its purpose was to disseminate knowledge of the value of nitrate as a fertilizer and thereby to increase its consumption. In 1896 this association was incorporated under the laws of the Chilean Government.

The association, which includes practically all of the producers in Chile, has been in existence continuously since its formation. The Government of Chile, which is especially interested in the growth of the industry because of the large revenues obtained from the export tax and the sale of its lands, contributes about one-third of the expense of the association and the remainder is contributed by members, who pay about three-fourths of a cent per quintal (101 pounds) of nitrate exported. Voting power in the association is based on the number of quintals exported. The management of the association resides in a directing council composed of 20 members, 10 being named by the producers and 10 by the Chilean Government. Its headquarters are at Valparaiso.

The association has established branches in most of the important European countries and also in the United States. These branch offices issue publications and conduct experiments showing the value of nitrate as a fertilizer. The propaganda work has been an important factor in bringing about a rapid increase in the consumption of nitrate as a fertilizer in a number of countries. From 1891 to 1908 the increase amounted to almost 100 per cent.

The propaganda association also publishes in its quarterly circulars extensive statistics of production, exportation, consumption, etc., which show in detail the progress of the industry.

Exportation of nitrate.—Much of the nitrate produced in Chile is sold through commission houses to exporters. These exporters purchase their nitrate in the Valparaiso market, export it from the several ports, and sell it in the various markets of the world. Practically the entire exportation of nitrate from Chile is handled by about 25 exporters, several of whom are also producers. Table 5 shows the quantities exported by each of the principal concerns during the years 1910 to 1913, inclusive. The four concerns exporting the largest quantities are Antony Gibbs & Co., of Liverpool; Fölsch & Co., and Weber & Co., of Hamburg; and W. R. Grace & Co., of New York.

TABLE 5.—NITRATE EXPORTS FROM CHILE, BY PRINCIPAL CONCERNS, 1910–1913.[1]

Concern.	Total net tonnage for calendar year—			
	1910	1911	1912	1913
Ahuja, E	143,014	128,494	82,554	102,118
Amelia Nitrate	1,768	6,794	558	....
Balfour, Williamson & Co	36,683	55,219	34,144	15,345
Buchanan, Jones & Co	....	....	....	154,592
Fölsch, H., & Co	430,665	562,139	443,341	304,830
Gibbs & Co	67,295	94,418	269,810	575,037
Gildemeister & Co	22,428	....	....	....
Grace, W. R., & Co	351,695	323,034	339,583	350,316
Graham, Rowe & Co	10,404	7,028	....	....
Groothoff, A. & O	13,112	1,116	....	3,293
Huth & Co	76,800	59,234	48,152	101,507
Kenrick, George C., & Co	5,394	....	....	11,028
Lautaro Nitrate Co	7,827	73,419	78,853	86,988
Lockett Bros	2,024	5,838	....	....
Lomax, I., & Co	260,717	237,819	257,317	....
Mitrovich Bros	114,096	147,648	82,669	149,259
Moir & Murphy	....	....	22,310	21,055
Société Commerciale Française	71,783	9,612	....	....
Vorwerk & Co	132,227	182,754	183,503	251,043
Weber & Co	398,075	431,525	441,420	475,046
Weir, A., & Co	39,005	34,989	....	7,743
Wessel, Duval & Co	123,760	86,389	85,792	126,326
Wilms, William	204,225	204,721	203,166	218,942
All others	37,924	28,668	31,713	48,475
Total	2,550,921	2,680,858	2,604,885	3,002,943

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[1] Compiled from trade circulars of Weber & Co., of Valparaiso. A small quantity is not accounted for so that the total shown is a little less than the total exports shown in Table 6, below.

Table 6 shows the distribution of nitrate exports to Europe, including Egypt, and to the east coast and west coast of the United States during the years 1907 to 1913. Of the total exports, amounting in 1913 to 3,018,424 net tons, 2,227,003 tons, or 73 per cent, went to Europe, including Egypt, and 695,307 tons, or 23 per cent, to the United States. Of the quantity exported to the United States, 68,735 tons were sent to the west coast and the remainder to Atlantic and Gulf ports.

TABLE 6.—NITRATE EXPORTS FROM CHILE TO EUROPE, THE UNITED STATES, AND OTHER COUNTRIES, BY YEARS, 1907–1913.[1]

Year.	Europe (including Egypt).	United States.		Other countries.	Total.
		East coast.	West coast.		
	Net tons.	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*
1907	1,391,670	335,069	45,848	52,886	1,825,473
1908	1,835,611	325,899	40,697	58,509	2,260,716
1909	1,773,233	439,324	66,464	74,306	2,353,327
1910	1,849,000	579,473	50,787	95,607	2,574,867
1911	2,052,324	501,540	61,274	84,920	2,700,058
1912	2,108,091	476,903	57,594	105,493	2,748,081
1913	2,227,003	626,572	68,735	96,114	3,018,424

[1] Compiled from quarterly circulars of the Nitrate Propaganda Association.

Both steamers and sailing vessels are operated in the nitrate-carrying trade to European ports, while the former are used exclusively in the United States trade. Shipments to Hamburg are largely in sailing vessels, the time consumed in going to Hamburg being from 90 to 100 days. The time consumed by steamers in going to New York before the opening of the Panama Canal was from 45 to 65 days, while now the voyage can be made in 21 days.

W. R. Grace & Co. and possibly some other exporters own their steamers, but as a rule nitrate of soda is shipped in chartered vessels. As a result, the exportation of nitrate of soda is subject to the fluctuations of the market for ocean freights and the charter rate is an important item in the cost of placing the nitrate in the world markets. The effect of this factor on prices during 1911 and 1912 is discussed in more detail in Chapter VI. (See p. 126.)

Considerable difficulty is experienced at times in loading the vessels with nitrate, as there are no harbors at the nitrate ports and everything has to be lightered, a difficult thing to accomplish when the surf runs high. Frequently the harbor masters declare that no loading shall be attempted.

In order to supply the demand arising in various markets, many of the cargoes leave Chilean ports with their destination optional. In such cases they receive telegraphic orders at various points along the route. The vessels of W. R. Grace & Co. and Wessel, Duval & Co. receive orders at Santa Lucia in the West Indies. Although their vessels are usually ordered to one of the principal Atlantic seaports, they are occasionally diverted to European ports if a better market is offered.

The exportation and sale of nitrate of soda as now conducted is a highly speculative occupation. It also requires a large amount of capital. For this reason only a few concerns are regularly engaged in the trade. An ordinary cargo of 6,500 tons costs about $250,000. When an exporter purchases such cargo he deposits a 90-day sight draft on London for the value of the nitrate alongside vessel, which vessel he usually charters. The charter rate and the prices in the different markets are both continually fluctuating. If the shipper has his cargo contracted for, his principal risk is a sudden increase in ocean freights. If, however, he ships a cargo to be sold subsequent to its departure, he takes the risk of a fall in price before it is disposed of.

The speculative nature of the nitrate export business is enhanced by the lack of adjustment between production and consumption. The demand for nitrate for fertilizer is seasonal and influenced by a variety of factors, such as the price of particular crops, competition of substitutes, etc. High prices for beet sugar, cotton, etc., on which crops nitrate of soda is especially used, tend to stimulate demand, while low prices have the opposite effect. Thus, while world consumption may be fairly regular, consumption in particular markets is decidedly irregular. The distances from Chile to the world markets and the time and uncertainties of transportation add to the maladjustment. There may be an ample supply of nitrate awaiting shipment in Chilean ports and a severe shortage in the consuming markets which it may take weeks to relieve if a supply of vessels is not available at the moment. Finally, high prices in the principal markets tend to curtail consumption, but stimulate production in Chile, while low prices produce the opposite results. All these factors combined offer exceptional opportunity to the exporters engaged in the nitrate trade to manipulate shipments and to engage in speculative campaigns. To the intense as well as violent fluctuations of nitrate prices must be added the no less violent changes in the rate of exchange of Chilean money in London, all of which offers a broad field to speculation. The influence of speculation and other factors on prices is discussed in detail in Chapter VI (see p. 127).

Consumption of nitrate.—Approximately three-fourths of the total production of nitrate of soda is estimated to be consumed for fertilizer purposes. The remainder is used for the manufacture of explosives and for chemical purposes. Germany is the largest consuming country of nitrate in the world. In 1913 she consumed about 41 per cent of the total exports to Europe and more than 32 per cent of the world's consumption. In the same year the United States consumed about 23 per cent. Table 7 shows the consumption of nitrate for all purposes by the principal European countries, and also by the United States, for the period 1909 to 1913, inclusive.

TABLE 7.—CONSUMPTION OF NITRATE OF SODA IN THE PRINCIPAL WORLD MARKETS, 1909–1913.[1]

Country.	1909	1910	1911	1912	1913
	Net tons.	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*
Total Europe (including Egypt)	1,700,015	1,927,671	1,934,968	2,196,833	2,072,000
Germany	777,166	865,894	819,094	1,004,803	917,927
France	311,601	372,019	373,188	390,608	360,501
Belgium	272,743	316,933	334,706	341,357	350,941
Holland	115,560	153,310	159,378	199,343	181,249
England and Scotland	128,995	139,884	146,464	151,404	141,648
Italy	61,098	50,433	59,074	49,080	56,952
Austria-Hungary	14,204	6,519	5,818	7,838	8,203
Spain	18,648	12,071	9,891	14,934	14,489
Other countries	....	10,608	27.355	37,466	40,090
Total United States	475,225	577,725	625,974	485,947	649,168
East coast	419,777	521,110	565,257	425,313	581,840
West coast	55,448	56,615	60,717	60,634	67,328
All other countries	80,257	95,608	84,920	105,493	96,114
Grand total	2,255,497	2,601,004	2,645,862	2,788,273	2,817,282

[1] Compiled from quarterly circulars of the Nitrate Propaganda Association.

As shown by the preceding table, the total consumption of nitrate in the United States, which is based on imports, amounted in 1913 to about 649,168 net tons. Various informants in close touch with nitrate conditions have submitted to the Federal Trade Commission the following estimates of the percentage of nitrate imports consumed in different industries in this country in 1913:

Estimate.	Explosives.	Fertilizers.	Chemicals, etc.
	Per cent.	*Per cent.*	*Per cent.*
No. 1	35	55	10
No. 2	39	47	14
No. 3	40	50	10
No. 4	40	40	20
No. 5	41.4	41.3	17.3
No. 6	40	40	20

The above estimates show a range of from 35 to more than 41 per cent for explosives, 40 to 55 per cent for fertilizers, and 10 to 20 per cent for chemical, glass, and dye works.

The Federal Trade Commission's estimate of the consumption of nitrate of soda in the United States for fertilizer purposes during the calendar year 1913 was 260,000 tons, as follows:[1]

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[1] The quantity of nitrate of soda used in mixed fertilizers is based on the reports of 24 companies, including the 7 largest (Ch. VIII, p. 170). They used in 1913 season 69,909 tons of nitrate of soda and 86,173 tons of sulphate of ammonia in 2,758,069 tons of ammoniated fertilizers sold. On the basis of 15 units of nitrogen in nitrate of soda and 20.5 units in sulphate of ammonia, the 24 companies used 2,815,181 units of nitrogen from these two sources, or 1.03 units per ton. The total estimated sales of ammoniated fertilizers in the United States in the 1913 season were 4,772,425 tons (Ch. VIII, p. 170). On the basis of 1.03 units per ton this would require 4,915,560 units of nitrogen from nitrate of soda and sulphate of ammonia. Deducting the 2,815,181 units used by the 24 companies leaves 2,100,379 units for all other companies, of which 900,000 were supplied

	Tons.
Used in mixed fertilizers	150,000
Sold to farmers in unmixed form	90,000
Used in making sulphuric acid for acid phosphate, base goods, and sulphate of ammonia	20,000
Total	260,000

The total of 260,000 tons equals about 40 per cent of the total quantity consumed in the United States during this year, which is given above as 649,168 tons.[1]

American importers.—Prior to 1913 practically all the nitrate of soda brought into the United States came through W. R. Grace & Co. and Wessel, Duval & Co., two importers, with headquarters in New York, and the E. I. du Pont de Nemours Powder Co., of Wilmington, Del. The imports of the last-named company do not enter the competitive market for fertilizer materials to an important extent, but are consumed mainly in the manufacture of explosives. At different times Balfour, Williamson & Co., an English concern, with offices in New York, have attempted to enter the market but without success. In the latter part of 1913 another English firm, Antony Gibbs & Co., of London, imported a considerable quantity of nitrate which they sold through H. J. Baker & Bro., one of the leading fertilizer brokerage concerns of New York, and after several months of price cutting against the other two New York importers succeeded in retaining a place in the market. The American Agricultural Chemical Co. and the Armour Fertilizer Works sometimes import cargoes of nitrate which they have purchased in the Liverpool, Hamburg, or Valparaiso market.

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by sulphate of ammonia, and the balance of 1,200,378 units by nitrate of soda, which is equivalent to 80,025 tons. The quantity of sulphate of ammonia available for fertilizer purposes in the 1913 season has been placed at 130,000 tons (see p. 175). Of this quantity more than 86,000 tons were used by the 24 companies, leaving about 44,000 tons, equivalent to 900,000 units of nitrogen for all other companies. Adding the 69,909 tons used by the 24 companies to the 80,025 tons, the estimated quantity by all other companies makes a total of 149,934 tons of nitrate of soda in mixed fertilizers. In the estimate given above, however, 150,000 tons are used.

The quantity sold to consumers in unmixed form is estimated by taking about 1⅓ per cent of the total sales of fertilizer in the United States given above. In Georgia the sales of nitrate of soda to consumers in the 1914 season was more than 1.5 per cent of the total sales. (Ch. VII, p. 161.)

The quantity of nitrate used in the manufacture of the sulphuric acid going into acid phosphate, base goods, sulphate of ammonia, and other fertilizers is estimated at about 1 per cent of the quantity produced for fertilizer purposes. This has been conservatively estimated at 2,170,000 tons. (Ch. IV, p. 102.)

[1] Special attention has been given to this point because of the frequent misstatements made that only from 13 to 15 per cent of the imports of nitrate of soda was used for fertilizer purposes. The seven largest fertilizer concerns in the United States used in mixed goods alone in 1913 about 8.5 per cent of the total imports of nitrate. Most of these companies also sold in bag lots, for fertilizer purposes, more nitrate than they used. Smaller concerns used more nitrate proportionately than the seven largest.

The following table shows the tons of nitrate imported into the United States by companies in 1913, as stated by a large importer:

TABLE 8.—ESTIMATED IMPORTS OF NITRATE OF SODA INTO THE UNITED STATES, BY COMPANIES, CALENDAR YEAR 1913.

Company.	Gross tons.	Company.	Gross tons.
W. R. Grace & Co	355,900	Antony Gibbs & Co	10,700
E. I. du Pont de Nemours Powder Co	118,300	Armour Fertilizer Works	8,875
Wessel, Duval & Co	111,200	Balfour, Guthrie & Co	5,600
The American Agricultural Chemical Co	14,000	Meyer, Wilson & Co	3,300
Pacific Guano & Fertilizer Co	11,600	Total	639,475

W. R. Grace & Co. is a Connecticut corporation with a capital stock authorized of $25,000,000, of which there is issued and outstanding $11,708,100. The company does an importing and exporting business and also a general freight-carrying business between the United States and various South American ports. This company imports approximately 50 per cent of the nitrate of soda brought into the United States. In 1914 it owned a fleet of nine steamers, known as the Merchants Line, and sometimes charters additional vessels. It controls two subsidiary companies: (1) the Nitrate Agencies (Ltd.), an English corporation, which owns dock and warehouse facilities at a number of nitrate ports in Chile; and (2) the Nitrate Agencies Co., a West Virginia corporation, with offices in almost all of the principal fertilizer centers, organized for the purpose of distributing nitrate and other fertilizer materials directly to mixers and consumers.

Wessel, Duval & Co. is a partnership with English connections. It does an importing and exporting business and operates a fleet of seven chartered steamers, known as the West Coast Line of Steamers, plying between the United States and the principal ports of Chile and Peru. It also charters additional vessels when needed.

When Wessel, Duval & Co. first entered the market, and for some time subsequent thereto, there was sharp competition between the two houses, and sales were said to have been made at a loss in order to get and keep the trade, but for some time past there has been no active competition between them, their prices of nitrate and freight rates on merchandise being about the same. Since the conclusion of the price war they have frequently exchanged nitrate when one happened to have a shipload in a port where the other had an order to be filled.

Again, in 1913, when Antony Gibbs & Co. entered the American market, another sharp price war occurred, which was still in progress in June, 1915.

A variety of factors combine to restrict the American market for nitrate largely to these two or three regular importers now controlling the business. In addition to the speculative nature of the business and the large capital required, which have already been mentioned, the absorbing capacity of the American market is much less than that of Europe, so that it is more difficult to dispose of cargoes not previously contracted for. W. R. Grace & Co. and Wessel, Duval & Co. have warehouses at a number of ports to hold their surplus imports. An outsider not having these facilities is at a disadvantage, for the inflammable nature of bagged nitrate requires special warehouses and makes it expensive to store. Another factor is the lack of return cargoes for chartered vessels coming from Chile to United States ports. W. R. Grace & Co. and Wessel, Duval & Co. have built up an export business to the South American market and use nitrate of soda as a return cargo for their vessels. Finally, an outside concern can invade the American market only by engaging in a price-cutting campaign, which is apt to result in heavy losses. It must be strong enough financially to sustain such losses for a considerable period in order to retain a share of the American trade.

Whether these factors have enabled the two principal importers to charge unduly high prices for nitrate is discussed in Chapter VI.

Section 3. Air nitrates.

Several inorganic nitrogenous materials are now manufactured from the air by electrical process, but only three of these—calcium cyanamid, nitrate of lime, and synthetic sulphate of ammonia—are as yet sold in important quantities for fertilizer purposes.[1] The others, such as nitrate of soda and nitrate of ammonia, are used mostly in the manufacture of explosives and in chemical industries, since their cost of production is too high to permit of their use as fertilizers. Nitrate of ammonia, if it could be produced more cheaply, would make an ideal fertilizer, since it contains 35 per cent of nitrogen and has no undesirable or useless constituents. In 1913 about 1,000 tons of this material were imported into the United States, practically all of it going into the manufacture of high-grade explosives. No artificial nitrate of soda was imported.

Two distinct processes are employed in the fixation of atmospheric nitrogen: The calcium cyanamid process, such as is used at Niagara Falls in making cyanamid, and the arc process, such as is used at Notodden, Norway, in the manufacture of nitric acid, nitrate of lime, nitrate of soda, and nitrate of ammonia. In both of these processes electrical furnaces of high temperature are necessary, and, in order to secure current for these furnaces and at the same time make the business practicable, the factories must be located near cheap and adequate water power. The principal plants now in operation are located in Norway, Italy, Switzerland, and at Niagara Falls, Canada. The distance from market makes the establishment of the industry impracticable in some parts of the world, even though cheap water power is available. The cyanamid industry is also dependent upon cheap coke which is used in making calcium carbide, one of the essential ingredients.

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[1] The production of synthetic sulphate of ammonia is discussed in the following section (see p. 39).

The success and development of the air-nitrate industry as far as the production of fertilizer materials is concerned, depends upon the relation of the cost of manufacture and distribution to the price of nitrate of soda and sulphate of ammonia in the principal markets.

Calcium cyanamid.—Calcium cyanamid is a dark-colored salt, usually containing from 18 to 23 per cent of ammonia or from 15 to 19 per cent of nitrogen.[1] It compares favorably in efficiency with sulphate of ammonia. In the United States cyanamid is used by fertilizer manufacturers as a source of ammonia in their mixed goods, very little, if any, being used by farmers for direct application. The particles of calcium cyanamid are soft and porous and readily neutralize or absorb the free acid or moisture in acid phosphate and other materials. Hence, it is claimed to be an advantage to use it in mixed fertilizer, since it acts as a neutralizer, improves the mechanical condition of the mixtures, and makes them better fitted for use in drills. If used in too large quantities, however, it has a tendency to cause a reversion of the acid phosphate. The usual practice is to use from 60 to 80 pounds to the ton of complete goods. It can not be used to advantage with sulphate of ammonia or wet fish scrap since its lime content liberates the ammonia, but it enters beneficially into combination with any of the other ammoniates.

Cyanamid is not well suited for direct application to the soil. In Europe, because of this fact, considerable attention has been given to the conversion of calcium cyanamid into sulphate of ammonia. Cyanamid readily gives off its nitrogen in the form of ammonia when heated, and in many of the works there are installations for making this conversion. It is also being used in the manufacture of nitric acid, ammonium nitrate, etc.

In making cyanamid atmospheric nitrogen is combined with calcium carbide at a moderately high temperature.[2] The nitrogen used is obtained either by the copper-oxide process or by the fractional distillation of liquid air. In the former case air is passed through a red-hot mass of finely divided copper suspended in asbestos or other inert material. The oxygen in the air unites with the copper leaving the nitrogen free. In the latter process, which is in more general use, air is liquefied and the oxygen separated from the nitrogen by evaporation.

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[1] The chemical formula is $CaCn_2$.

[2] The calcium carbide is finely ground and packed into small ovens made of perforated iron or steel and enclosed in some nonconducting material such as fire brick. In the center of each is a carbon connected with an electric current for the purpose of producing heat. When a number of these ovens are filled, they are placed in a chamber in which the air is displaced by a steady flow of nitrogen. The electric current is then turned on and the temperature of the ovens is raised to from 1,000° to 1,100° C. at which point the carbide begins to combine with the nitrogen. After remaining in the chamber for 30 or 40 hours, the ovens are removed and allowed to cool from 8 to 12 hours, when the black, porous mass, which is now calcium cyanamid, is taken from them and ground to a powder. This powder is sometimes further treated by mixing with it certain substances such as tar, petroleum, or asphalt, since the powdered form is disagreeable to handle.

The calcium carbide used in making cyanamid is the result of fusing a mixture of lime and coke in an electrical furnace at a high temperature. It requires about 4 tons of the material to combine with 1 ton of nitrogen to form a 20 per cent grade of cyanamid.

Not much is known concerning the cost of manufacturing calcium cyanamid, as all the processes are protected by patents. There seems, however, to be quite a wide difference between the costs of individual factories. In 1909 it was stated that one of the French factories manufactured it at a cost of $32.22 per short ton, the selling price being $40.27 at that time. At the Odda, Norway, factory the cost has been placed as low as $22.

The first cyanamid factory was built at Piano d'Orte on the Piscara River, Province of Chiete, in central Italy, and began operations in 1906. After a few years plants were established in other European countries, and to-day they are in operation in many parts of the world, there being 15 plants with an annual productive capacity estimated at 333,500 net tons. Four of these plants are located in Germany, three in Italy, two in Switzerland, two in Austria, and one each in Norway, Sweden, Japan, and Canada. At present there is invested in the industry approximately $30,000,000. In addition to those already built, factories are projected for India and South Africa, and the English Cyanamid Co., of Great Britain, is contemplating the application of 1,000,000 continuous horsepower to the production of cyanamid and its derivatives, 600,000 of which has been secured in Norway and 400,000 in Iceland.

The most important of the calcium cyanamid works in Europe is the plant at Odda, Norway, owned by a London corporation in which English, German, and Italian capital is invested. The estimated capacity of the plant is 72,000 tons. Practically all the material produced is exported.

No cyanamid factory has yet been established in the United States, although there was a project to build a plant on the Coosa River in Alabama. The factory in Canada, however, which is operated by the American Cyanamid Co. at Niagara Falls, Ontario, sells largely to the American market.

The American Cyanamid Co.—The American Cyanamid Co. is a Maine corporation, organized in July, 1907. It has $5,000,000 common stock and $6,000,000 6 per cent preferred stock authorized, of which $2,500,000 of common and $3,276,300 of preferred have been issued. Most of this stock is held in England. There is no bonded indebtedness outstanding.

The company has a contract with the Ontario Power Co. to supply all of its power. The original capacity of the plant was 12,000 tons per annum, but it has recently been increased to 64,000 tons. The production of cyanamid at this plant has been on a commercial basis only since 1912. Prior to this date the quantities produced were used in furnishing samples for testing, etc., in propaganda work. The production for the fiscal years 1912 and 1913 was 11,127 and 27,415 tons, respectively, practically all of which was used in the United States. The sales for the year ending March 31, 1913, were 15,488 tons and for the fiscal years ending June 30, 1914 and 1915 were 37,586 and 22,876 tons, respectively.

The cyanamid produced at Niagara Falls is sold on the unit basis, since the product varies somewhat in nitrogen content. For instance, in 1914 the price of powdered cyanamid ranged from $2 per unit of ammonia f. o. b. Niagara Falls for large shipments to $2.40 per unit for small quantities, with an average of about $2.15 per unit. On an analysis of 18 per cent of ammonia, i. e., 18 units per ton, this would make the price per ton range from $36 to $43.20 f. o. b. Niagara Falls. There is no import duty on this material.

Sales to the large fertilizer manufacturers, who are the principal consumers of cyanamid, are made directly by the company. Sales through brokers are encouraged, however, the commission being at the rate of 1 per cent of the net receipts.

Nitrate of lime.—Of the various air nitrates, nitrate of lime has also been used to some extent as a nitrogenous fertilizer. It is a white salt obtained by combining the nitric acid produced by electrical process with calcium.[1] The nitrogen content of nitrate of lime is 13 per cent as compared with 15.5 per cent of nitrogen contained in Chilean nitrate of soda. On soils where lime is needed it is more effective than nitrate of soda, the sodium in the latter being useless for fertilizer purposes. Nitrate of lime is manufactured principally by the Norwegian Nitrate Works Co., the annual production being about 90,000 tons. In Germany the Bayerische Stickstoffwerke also manufactures considerable quantities of the material, as well as some sulphate of ammonia. Other works are being constructed in Spain. The principal defect in nitrate of lime is that it absorbs moisture very readily and deteriorates in quality if exposed to the air. Accordingly it has been found necessary to ship it in casks instead of in bags. It is also disagreeable to handle. For these reasons nitrate of lime, like cyanamid, is being converted into various derivatives.

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[1] The chemical formula is $Ca(NO_3)_2 4H_2O$.

Nitrate of lime is made by what is known as the arc process, the general principle of which consists in passing air through an electrical flame, causing the nitrogen and oxygen to combine. At present three methods of applying electrical energy in this way are in commercial use. These are the Birkeland-Eyde process, the Schönherr process, and the Pauling process. There are also several other methods, but they are still in the experimental stage.[1]

The several processes for making nitrate of lime differ principally in the manner in which the electrical flame is produced. Both the Birkeland-Eyde and the Schönherr processes have been successfully employed by the Norwegian Nitrate Works Co. since 1907. The Pauling system has also been in successful operation in a plant at Patsch, near Innsbruck, Austria, for several years, and in another plant at Legnano, near Milan, Italy, which is now manufacturing nitric acid. A third factory, using 25,000 horsepower, has been constructed by a French company near Briançon. A factory equipped with the Pauling system has been built in North Carolina for the manufacture of nitrate of lime, but it is still in an experimental stage.

Distribution of foreign air nitrates.—The sales of air nitrates used for fertilizer to consumers in Europe appear to be handled through central selling agencies. The Verkaufsvereinigung für Stickstoffdünger, of Berlin, is the bureau charged with the sales of cyanamid in Germany, Holland, Denmark, Russian Poland, and the Baltic Provinces of Russia.[2] The Société Anonyme L'Azote, of Paris, has control of the sales in France, Belgium, Switzerland, and southern Europe.

Between 3,000 and 4,000 tons of nitrate of lime are imported annually into the United States from Europe for fertilizer and other purposes. The supplies come almost entirely from Norway. Of this quantity 300 to 400 tons are imported upon the Atlantic coast and the remainder upon the Pacific coast, where this material is used largely by the citrus fruit growers in California. Hawaii also takes considerable quantities for fruit orchards and sugar plantations. The distribution of this material in the United States is through exclusive agents.

Section 4. Sulphate of ammonia.

Sulphate of ammonia is an oderless salt of a grayish-white, bluish-white, or brown color,[3] the variations being due to the presence of iron, tarry matter, or other foreign substances. It is very soluble, dissolving completely in about twice its weight of cold water. The bulk of the commercial sulphate produced in the United States is guaranteed to contain 25 per cent of ammonia, equivalent to 20.55 per cent of nitrogen, or about 96.9 per cent of pure ammonium sulphate. A small quantity of the brown sulphate of ammonia containing 24 per cent of ammonia is also produced in this country. In Europe a considerable quantity of the commercial sulphate contains 24.5 per cent of ammonia, equivalent to 20.14 per cent of nitrogen, but only the 25 per cent grade is imported into the United States.

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[1] For a complete description of the arc processes of making air nitrates see address of Samuel Eyde on the "Oxidation of atmospheric nitrogen and development of resulting industries in Norway," delivered at the Eighth International Congress of Applied Chemistry, 1912. Also see article of G. Cecil Jones on the "Utilization of atmospheric nitrogen," published in the Chemical Trade Journal and Chemical Engineer, January 17, 1914, and report of Thomas H. Norton on Utilization of Atmospheric Nitrogen, Bureau of Manufactures, Special Agents Series—No. 52, Washington, 1912.

[2] Production et Consommation des Engrais Chimiques dans le Monde, 1913, p. 24.

[3] The chemical formula is $(NH_4)_2SO_4$.

When sulphate of ammonia is added to the soil, some of the ammonia may be absorbed by plants directly while the remainder is first converted into nitrates. An objection sometimes urged against sulphate of ammonia is that its continued use has a tendency to "sour" or produce an acid condition of the soil deleterious to some crop plants. As a fertilizer, sulphate of ammonia is somewhat slower in its action than is nitrate of soda, but it has one important advantage over nitrate in that its ammonia is absorbed by soils in such a way that it is less subject to leaching.

Sources of sulphate.—Commercial sulphate of ammonia is at present obtained largely from the following sources:

(1) Destructive distillation of bituminous coal in the manufacture of coke.

(2) Destructive distillation of bituminous coal in the manufacture of gas.

(3) Manufacture of bone black in bone-carbonizing works.

(4) Recovery from splint coal used in blast furnaces.

(5) The manufacture of coal oil from shale.

(6) Synthetic process.

In the first five of these processes sulphate is essentially a by-product, while in the synthetic process it is a direct product. There are several other sources of sulphate, but the commercial production from them is relatively unimportant.

The first three sources named are the only ones from which sulphate is obtained in the United States, and of these the destructive distillation of coal in the manufacture of coke is the most important. During the year 1913 by-product coke ovens furnished 96.2 per cent of the total production. There are now only two concerns producing sulphate of ammonia as a by-product in the manufacture of bone black in bone-carbonizing works, and only two gas companies report the production of sulphate of ammonia from their ammonia liquor. But there are several chemical manufacturing companies which at times have produced sulphate from ammoniacal liquor purchased from various coal gas companies and manufacturers of by-product coke. The most important concern converting liquor thus purchased into sulphate is the Cochrane Chemical Co., of Boston, Mass.

The leading European countries producing sulphate of ammonia are Germany, England, France, and Belgium. In the United Kingdom illuminating gas works furnish the principal source of sulphate, and iron, shale, coke, carbonizing and producer-gas furnaces furnish the balance. In Germany coke and gas concerns furnish the principal source, although recently the Badische Anilin-und-Sodafabrik has begun the manufacture of ammonium sulphate by the synthetic process. In France and Belgium by-product coke ovens furnish the principal source, with gas works second.

Description of the coking process.—In order to produce a high-grade coke, such as is required for metallurgical purposes, coke manufacturers use coal which contains from 22 to 30 per cent of volatile matter. This coal contains from 1 to 2 per cent of nitrogen and will yield on the average twenty pounds or more of ammonium sulphate to the ton. During the coking process part of this nitrogen in its free state is driven off in the gas, uniting with hydrogen to form ammonia. The amount recovered depends upon the physical character of the coal, the efficiency of the plant, and the length of coking time. The ammonia thus recovered is either combined with sulphuric acid to make ammonium sulphate or concentrated to make different grades of ammonia liquor.

The three leading systems of coke ovens in this country from which sulphate of ammonia is recovered are the Koppers, Otto (including the Otto-Hoffman and United-Otto types), and the Semet-Solvay. In all the modern installations of these systems the sulphate is made by what is known as the direct process, i. e., by passing the gas from the coke ovens first through extractors which take out the tar and then through a sulphuric-acid bath where the ammonia gas is separated from the other gases by uniting with the sulphuric acid to make ammonium sulphate. In the older installations, some of which are still in operation, what is known as the indirect process is employed. By this method the gases are "scrubbed" in a washer with water which at ordinary temperature absorbs 708 times its volume of ammonia gas, thus forming a weak solution which contains from one-half to 2 per cent of ammonia. This liquor is treated with steam and lime in a still and the ammonia gas is driven off into a saturator, where it combines with sulphuric acid, causing precipitation of the ammonia in the form of sulphate. The contents of the saturator are then removed to a dryer where the precipitate is separated from the liquor and the latter is returned to the saturator.

Where the recovery of ammonia is desired in the form of ammonia liquor the first step of the indirect process is employed. The aqueous solution coming from the washer and containing from one-half to 2 per cent of ammonia can only be consumed locally, because of the cost of transportation. But recently there has been introduced a process whereby the liquor can be concentrated so as to contain as much as 25 per cent of ammonia, thus enabling the producer to market the product at more distant points. Ammonia liquor is used in making anhydrous and aqua ammonia for refrigeration and other purposes, and is also a prime factor in the production of soda ash, explosives, and heavy chemicals.

Besides ammonia liquor and ammonium sulphate, several other by-products, such as tar, benzol, coke dust, and breeze are obtained from by-product coke ovens. Also the surplus gas from the ovens is recovered and used for heating and illuminating purposes. In the beehive ovens, which are still used extensively in this country, only a form of tar is recovered, all the gas from the coking process being allowed to escape without treatment.

Other processes of production.—The retort ovens used by gas works are somewhat different from those used for coke making, but the method of recovering the ammonia is essentially the same. The recovery in the first instance is always in the form of ammoniacal liquor. Two gas plants, however, report installations for the conversion of the liquor into ammonium sulphate. A similar method of recovering the ammonia is also employed by bone-carbonizing works. The bones are heated in a retort oven, the nitrogenous matter passing off as a gas leaving the residue, known as bone black, which is used principally in sugar refining. The ammonia in the gas is recovered in the form of liquor and then converted into sulphate or carbonate of ammonia.

The production of ammonia from shale is carried on principally in Scotland. The ammonia is formed from the nitrogenous constituents of the shale by the dissociation and interaction with steam at temperatures between 750° and 1,350° F. A ton of shale in modern shale retorts yields from 25 to 75 pounds of sulphate. The shales giving the lowest oil yield usually return the highest yield of ammonia.

In the United Kingdom, particularly Scotland, ammonium sulphate is produced from the gases of the blast furnaces using splint coal, either alone or in combination with coke as fuel. The process of recovery is the indirect method described above. The annual output from blast furnaces has been for a number of years about 20,000 long tons.

In making sulphate by the synthetic process nitrogen and hydrogen are made to combine under pressure at a temperature of about 500° C., by means of a catalytic agent composed largely of uranium. The nitrogen is obtained by the distillation of air, and the hydrogen is obtained from steam. The recovery is in the form of a weak liquor, which is then converted into sulphate of ammonia or used for other purposes. This process was discovered by Prof. Haber, of Germany, and is now controlled by the Badische Anilin-und-Sodafabrik and employed at a plant near Ludwigshafen, Germany.

In Europe ammonium sulphate is also manufactured from cyanamid, as this compound surrenders all its nitrogen in the form of ammonia when treated with superheated steam. The ammonia thus liberated is absorbed in sulphuric acid and a pure commercial ammonium sulphate is produced.

Types of by-product coke ovens.—At the present time there are seven different types of by-product coke ovens in the United States, the three leading types, as stated above, being the Koppers, the Otto (Otto-Hoffman and United-Otto), and the Semet-Solvay. Others are the Rothberg, Klönne, Wilputte, and the Gas Machinery coke ovens. Still another type is the Roberts-Moss, one oven of which has been erected at Gary, Ind., for experimental purposes. The Semet-Solvay ovens, an American invention, are owned by the Semet-Solvay Co., a subsidiary of the Solvay Process Co., Syracuse, N. Y. They were the first by-product ovens to be built in this country. At the end of 1914, 1,689 of these ovens were in operation or ready for operation. The Otto-Hoffman oven, a German invention, the rights of which were acquired by the German-American Coke & Gas Co., was the second type to be used. The number has increased from 60 in 1895 to 1,990 at the present time. The Koppers type is also of German origin, the American rights being held by the H. Koppers Co., Chicago, Ill. Although not established in the United States until 1908, it now outnumbers any of the other types. In 1913 there were 2,177 of them in operation, of which 1,212 belonged to the United States Steel Corporation, which was the first company to install them. Comparatively few of the other types are in operation in this country.[1]

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[1] The type of oven and number of ovens operated by each company in 1914 was as follows:

KOPPERS COKE OVENS.

Company.	Location of plant.	Number of ovens.	
United States Steel Corporation:			
Illinois Steel Co.[a]	Joliet, Ill.	280	
Indiana Steel Co.[a]	Gary, Ind.	560	
Tennessee Coal, Iron & Railroad Co.[a]	Fairfield, Ala.	280	
Minnesota Steel Co	Duluth, Minn.	92	
			1,212
Lehigh Coke Co.[a]	South Bethlehem, Pa		424
Woodward Iron Co.[a]	Woodward, Ala.		170
Pennsylvania Steel Co:			
Maryland Steel Co.[a]	Sparrows Point, Md	126	
			126
Inland Steel Co.[a]	Indiana Harbor, Ind		86
Republic Iron & Steel Co	Youngstown, Ohio		68
Laclede Gas Light Co	St. Louis, Mo		56
Coal Products Manufacturing Co. of Joliet, Ill.[a]	Joliet, Ill		35
Total United States			2,177
Algoma Steel Coporation, Ltd	Sault Ste. Marie, Ontario (Canada).		110

[a] Produces sulphate of ammonia.

OTTO COKE OVENS.

Company.	Location of plant.	Number of ovens.	
Lackawanna Steel Co.[a]	Lebanon, Pa	228	
	Lackawanna, N. Y	188	
			416
New England Gas & Coke Co.[a]	Everett, Mass		400
Cambria Steel Co.[a]	Johnstown, Pa		372
United States Steel Corporation:			
Carnegie Steel Co.[a]	Farrell, Pa	212	
			212
Camden Coke Co	Camden, N. J		150
Pittsburgh Gas & Coke Co.[a]	Glassport, Pa		120
Hamilton, Otto Coke Co	Hamilton, Ohio		100
Citizens Gas Co. of Indianapolis	Indianapolis, Ind		100
Zenith Furnace Co	Duluth, Minn		50
Northwestern Iron Co	Mayville, Wis		40
Michigan Alkali Co	Wyandotte, Mich		30
Total United States			1,990
Dominion Iron & Steel Co., Ltd	Sidney, Nova Scotia (Canada)		520

SEMET-SOLVAY COKE OVENS.

Company.	Location of plant.	Number of ovens.	
Semet-Solvay Co.[b]	Syracuse, N. Y	40	
	Ensley, Ala.[a]	240	
	Detroit, Mich	175	
	Dunbar, Pa.[c]	110	
			565
By-Products Coke Corporation[a,d]	South Chicago, Ill		280
Pennsylvania Steel Co	Lebanon, Pa	90	
	Steelton, Pa.[a]	120	
			210
Milwaukee Coke & Gas Co	Milwaukee, Wis		160
United States Steel Corporation:			
National Tube Co	Benwood, W. Va	120	
			120
Cleveland Furnace Co	Cleveland, Ohio		100
Central Iron & Coal Co.[a]	Tuscaloosa, Ala		60
Kentucky Solvay Coke Co	Ashland, Ky		54
Empire Coke Co	Geneva, N. Y		46
Indianapolis Gas Co. (Citizens Gas Co. of Indianapolis)	Indianapolis, Ind		41
The Philadelphia Suburban Gas & Electric Co	Chester, Pa		40
North Shore Gas Co	Waukegan, Ill		13
Total United States			1,689

WILPUTTE COKE OVENS.

Company.	Location of plant.	Number of ovens.
Coal Products Manufacturing Co. of Joliet, Ill.[a]	Joliet, Ill	18

ROTHBERG COKE OVENS.

Company.	Location of plant.	Number of ovens.
Lackawanna Steel Co.[a]	Buffalo, N. Y	281

NATIONAL CHAMBER OVEN CO. (KLÖNNE COKE CO.)

Company.	Location of plant.	Number of ovens.
Seattle Lighting Co	Seattle, Wash	20
Central Indiana Gas Co	Muncie, Ind	22
Total		42

GAS MACHINERY COKE OVENS.

Company.	Location of plant.	Number of ovens.
Cambria Steel Co.[a]	Johnstown, Pa	28

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[a] Produces sulphate of ammonia.

[b] The Semet-Solvay Co., in addition to the plants owned, has retained some interest in all of those that it has built. Some of these it operates under lease; in others it has a stock interest; and in still others the interest is merely consulting.

[c] Semet-Solvay Co. and Dunbar Furnace Co.

[d] The By-Products Coke Corporation, Chicago, Ill., is operated independently of the Semet-Solvay Co. Individuals in one own stock and are officers in the other. The By-Products Coke Corporation relies on the Semet-Solvay Co. for expert advice in the operation of its ovens.

Domestic production.—The by-product coke ovens listed above furnish the bulk of the total domestic production of sulphate of ammonia. The following gas, chemical, and bone-carbonizing works produce the remainder:

Gas companies:	
Consolidated Gas Co. of New York	New York, N. Y.
Dayton Gas Co	Dayton, Ohio.
Chemical companies:	
Cochrane Chemical Co	Boston, Mass.
Pennsylvania Salt Manufacturing Co	Philadelphia, Pa.
Bone-carbonizing works:	
The American Agricultural Chemical Co	New York, N. Y.
Baugh & Sons Co	Philadelphia, Pa.

The sulphate produced by the Consolidated Gas Co. of New York is a by-product of the manufacture of cyanogen, which is used in mining and dyeing. The two chemical companies also produce their sulphate from ammonical liquor, which they obtain from gas or coke-oven companies, the conversion being made primarily for the purpose of obtaining sulphate. The Cochrane Chemical Co. consumes in its own plant a part of the sulphate it manufactures, and the two bone-carbonizing works consume their entire production in the manufacture of fertilizers.

Table 9, based on returns from companies, shows the total production of sulphate of ammonia by by-product coke ovens, also by gas, chemical, and bone-carbonizing works, by years, for the period 1907 to 1913, inclusive.

TABLE 9.—DOMESTIC PRODUCTION OF SULPHATE OF AMMONIA, BY YEARS, 1907–1913.

Year.	By-product coke ovens.	Gas works, chemical companies, and bone carbonizing works.	Total.	Per cent of total produced by by-product coke ovens.
	Pounds.	*Pounds.*	*Pounds.*	
1907	54,443,981	1,621,278	56,065,259	97.1
1908	51,964,455	4,019,999	55,984,454	92.8
1909	80,404,918	6,226,703	86,631,621	92.8
1910	89,669,248	5,736,442	95,405,690	94.0
1911	86,338,973	6,096,797	92,435,770	93.4
1912	130,778,246	7,968,927	138,747,173	94.3
1913	184,451,177	7,306,564	191,757,741	96.2

The production of sulphate of ammonia as distinguished from ammonia liquor has increased from 55,984,454 pounds in 1908 to 191,757,741 pounds in 1913, or 243 per cent in six years.[1] The 1913 production was more than twice that of 1911 and over 100 per cent greater than that of 1910. The 1913 increase over 1912 production was 38.2 per cent. The by-product coke-oven plants have produced more than 92 per cent of the total during the entire period 1907 to 1913, the per cent by years ranging from 92.8 per cent in 1908 to 96.2 per cent in 1913.

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[1] The figures usually given for the production of sulphate of ammonia both for the United States and European countries include all of the ammonia liquor produced converted to sulphate equivalent.

Of the by-product coke-oven producers, the United States Steel Corporation is by far the largest. In 1913 it produced 91,589,857 pounds, or 47.8 per cent of the total domestic output, while all other steel companies combined produced 36,011,131 pounds, or 18.8 per cent, and other by-product coke-oven concerns 56,850,189 pounds, or 29.6 per cent. The total output of gas companies, bone-carbonizing works, and chemical companies amounted to 7,306,564 pounds, or 3.8 per cent.

Relative production of ammonia liquor and sulphate of ammonia.—At the present time only about 60 per cent of the ammonia recovered by by-product coke ovens in this country is converted into sulphate of ammonia and made available for fertilizer purposes. The remainder, as above indicated, is converted into ammonia liquor and used for refrigeration, chemical, and other purposes. These uses compete directly with the demands of the fertilizer manufacturers for the ammonia output. The relative production of sulphate of ammonia and ammonia liquor depends largely on market conditions for these two by-products.[1] In the South there is practically no market for ammonia liquor, so that the output of the by-product coke-oven concerns in Alabama is almost entirely in the form of sulphate. In Illinois, and also in Pennsylvania, a market for liquor is found and large quantities are produced.

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[1] An official of one of the largest by-product coke-oven operators in answer to the question as to what economic and commercial factors determine the relative quantities of ammonia liquor and sulphate of ammonia produced wrote the Federal Trade Commission:

"The primary factor determining our practice * * * with regard to the relative quantities of ammonia liquor and sulphate of ammonia produced is the market demand for the two commodities. * * * The locations of the * * * plants we do not consider important factors in determining this practice. * * * As a general proposition we would ascribe changes in the relative quantities of the two by-products sold in different years to changes in market demand."

Similar statements from other important companies are as follows:

"The market conditions attending the demand for these products largely regulates the production and sales. * * * When the demand for sulphate falls off the plant is forced to make more liquor of ammonia in proportion. There is usually a better demand for sulphate in the cold months than during the warm months. The location of * * * plant with respect to the markets for the two by-products in question does not have any influence on the situation. Most of the sulphate has gone to consignees in the South, principally fertilizer manufacturers; and practically all of the liquor has gone into territory adjacent to the plant. The supply of sulphuric acid for use in making sulphate has not been a controlling or important factor in the matter of production of one or the other product."

"We are governed in the relative amount of ammonia liquor and ammonium sulphate produced by the orders furnished by the American Coal Products Co., and we understand the geographical location of our plant is just as good for either of the products."

"Location of plants adjacent to acid and fertilizer works avoids freight on sulphuric acid used and on a large portion of sulphate sold."

"Storage of sulphate of ammonia is inexpensive."

W. N. McIlravy, vice president of the American Coal Products Co., stated before the American Gas Institute in 1911 that—

"The consumption of ammonia in the form of concentrated liquor and similar forms is always taken care of first, as these forms do not require outlay for acid on the one hand and are more difficult of shipment on the other, which tends to reduce foreign competition."

It costs somewhat more to produce sulphate of ammonia than ammonia liquor due principally to the cost of the sulphuric acid in the former required to neutralize the ammonia, but it is doubtful if this factor exercises any appreciable effect upon the relative quantities of the two ammonia by-products produced. The excess of the cost of producing sulphate of ammonia over the cost of producing ammonia liquor at four large plants in the United States in 1913 per 100 pounds of ammonia (NH_3) and per 100 pounds of sulphate averaged as follows:

	Sulphuric acid.	Miscellaneous.	Total.
Average per 100 pounds of NH_3	$1.69	$0.90	$2.59
Average per 100 pounds of sulphate[1]	.4225	.225	.6475

[1] The cost figured on this basis is one-fourth of the cost per 100 pounds of NH_3, since the latter when treated with sulphuric acid yields four times its weight in sulphate of ammonia.

The higher cost of production of sulphate of ammonia, as compared with ammonia liquor, is offset to some extent by the lower freight rate for the transportation of the latter to market unless shipped in large quantities in tank cars and concentrated to 25 per cent ammonia.[1] It is also offset to some extent by the cost of concentrating the liquor which depends on the value of steam at the plant where made.

Imports of sulphate of ammonia.—Considerable quantities of foreign sulphate of ammonia are consumed annually in the United States, in addition to the domestic supply. The table following shows the imports of sulphate of ammonia by countries for the calendar years 1907–1913, as reported by the Bureau of Foreign and Domestic Commerce, Department of Commerce.

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[1] On the subject of freight on the two commodities an official of a large producer of sulphate of ammonia wrote the Commission as follows:

"In aqua ammonia the maximum amount of ammonia is about 20 per cent, while in sulphate it usually runs 25 per cent, which taken into consideration with the fact that freight rates on the former are about 25 per cent higher than on the latter, means a saving of at least 50 per cent in freight on present product shipped any distance when compared with ammonia in the form of liquor."

TABLE 10.—IMPORTS OF SULPHATE OF AMMONIA INTO THE UNITED STATES, BY COUNTRIES, FOR THE CALENDAR YEARS 1907–1913.

Country.	1907	1908	1909	1910	1911	1912	1913
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Scotland	....	....	58,135,141	107,341,798	103,861,690	74,587,339	67,920,194
England	....	....	21,712,022	55,508,170	68,231,681	28,408,829	27,865,754
United Kingdom	65,582,158	67,731,745	79,847,163	162,849,968	172,093,371	102,996,168	95,785,948
Germany	122,255	75,880	810,879	10,088,427	3,404,387	386,591	16,794,162
Belgium	....	1,107,391	90,017	3,155,102	4,911,046	1,547,850	....
Netherlands	1,692,182	....	....	448,314	....	....	1,321,200
Norway	....	....	....	....	....	....	60,194
Switzerland	....	....	2,343	....	....	....	....
France	110	88	132	330	....	....	....
Total Europe	67,396,705	68,915,104	80,750,534	176,542,141	180,408,804	104,930,609	113,961,504
Canada	314,459	1,232,000	2,122,000	2,296,000	7,736,993	12,180,995	15,689,746
Australia and Tasmania	2,729,828	6,328,000	2,956,800	4,726,400	1,120,000	1,972,798	896,781
Japan	....	....	....	1,121,993	....	....	....
Total	70,440,992	76,475,104	85,829,334	184,686,534	189,265,797	119,084,402	130,550,031

As shown by the table, imports of sulphate of ammonia increased from 70,440,992 pounds in 1907 to 189,265,797 pounds in 1911, then sharply declined to 119,084,402 pounds in 1912, and rose again to 130,550,031 in 1913. The United Kingdom furnished by far the greatest portion of the imports during the period covered by the table, those from Scotland very materially exceeding those from England. In 1911, the year when imports were largest, the United Kingdom furnished 172,093,371 pounds, or 90.93 per cent, of the total of 189,265,797 pounds. Scotland alone furnished 103,861,690 pounds, or 54.88 per cent. The imports from Scotland, however, have declined from 107,341,798 pounds, or 58.12 per cent of the total, in 1910, to 67,920,194 pounds, or 52.03 per cent, in 1913. The United Kingdom exported to the United States in 1913, 95,785,948 pounds, or 73 per cent of the total, of which England exported 27,865,754 pounds, or a little over 21 per cent. Germany and Canada both furnished more in 1913 than in any previous year. Norway made its first export to the United States, amounting to 60,194 pounds, in 1913. Japan has furnished none since 1910, when 1,121,993 pounds were exported to the United States. It is doubtful, however, if this was produced in Japan. Canada is the only country from which our imports of sulphate have continuously increased.

Consumption of sulphate of ammonia in the United States.—The total consumption of sulphate of ammonia in the United States from 1907 to 1913, inclusive, is shown in Table 11. This table shows the consumption of domestic sulphate; the imports by calendar years, taken from the Monthly Summary of Commerce and Finance; the total consumption; and the percentage of the consumption of domestic sulphate to the total consumption.

TABLE 11.—DOMESTIC CONSUMPTION OF SULPHATE OF AMMONIA, 1907–1913.

Year.	Consumption of domestic sulphate.[1]	Imports of foreign sulphate.	Total consumption.	Percentage of consumption of domestic sulphate to total consumption.
	Pounds.	*Pounds.*	*Pounds.*	
1907	55,621,439	70,440,992	126,062,431	44.1
1908	55,231,632	76,475,104	131,706,736	41.9
1909	85,582,638	85,829,334	171,411,972	49.9
1910	98,334,594	184,686,534	283,021,128	34.7
1911	89,580,448	189,265,797	278,846,245	32.1
1912	129,220,029	119,084,402	248,304,431	52.0
1913	186,136,922	130,550,031	316,686,953	58.8

[1] Consumption of domestic sulphate is based on shipments by producers reported to the Federal Trade Commission plus the production by the bone carbonizing works and such portion of the production of one chemical company as was consumed in its own plants.

The total consumption of sulphate of ammonia increased from 126,062,431 pounds in 1907 to 316,686,953 pounds in 1913, or about 150 per cent, the average yearly increase in consumption for the seven years covered by the table being about 25.2 per cent. At the same time the average yearly increase in the consumption of domestic sulphate was more than 21,700,000 pounds, or about 39 per cent. In 1911 the domestic sulphate furnished only 32.1 per cent, or less than one-third of the total consumption, while in 1912 it furnished 52 per cent and in 1913, 58.8 per cent of the consumption of sulphate.

Sulphate of ammonia is consumed mainly as a fertilizer, being used almost entirely by the fertilizer manufacturers and manipulators in mixed goods. Very little, if any, is used for home mixing, and the percentage of the total used for chemical purposes is small. Information obtained by the Commission indicates that in 1913 less than 10 per cent of the domestic production and practically none of the imported sulphate was used by chemical concerns. In former years the percentage of the total sales used for chemical purposes was somewhat larger, but the consumption for this purpose has remained fairly constant while that for fertilizer has expanded enormously.

Production and sale of sulphate in Europe.—Germany is at present the largest producer of sulphate of ammonia in the world, and also the largest consumer of this material for fertilizer. Its exports are only slightly larger than its imports, so that practically an amount equal to its whole production is consumed at home. The United Kingdom is the second largest producer of sulphate of ammonia. Prior to 1911 it was the largest. Approximately 77 per cent of the production in the United Kingdom is exported to other countries, and the remainder is consumed for domestic purposes. France is the third largest producer in Europe, but its production is now exceeded by that of the United States. The quantity produced annually is not sufficient to supply the domestic requirements, so that considerable quantities are also imported. The production, imports, exports, and consumption of sulphate of ammonia and sulphate equivalent in Germany, the United Kingdom, and France are shown in Table 12. The Commission has no information showing what proportion of the total production consists of ammonia liquor, although it is undoubtedly somewhat less than in the United States.

TABLE 12.—SULPHATE OF AMMONIA AND EQUIVALENT PRODUCED AND CONSUMED IN GERMANY, FRANCE, AND THE UNITED KINGDOM, 1908–1913.

Country.	1908	1909	1910	1911	1912	1913
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Germany:						
Tons produced [1]	313,000	330,000	373,000	418,000	485,000	550,000
Tons consumed	260,000	274,000	350,000	370,000	425,000	500,000
France:						
Tons produced [2]	52,600	53,600	57,300	62,500	69,000	74,500
Tons consumed [2]	84,000	78,500	73,086	84,026	91,000	100,000
United Kingdom:						
Tons produced [3]	325,228	349,143	367,587	384,976	388,308	431,618
Tons exported [4]	234,282	264,142	283,610	291,148	285,043	323,054
Tons consumed [5]	90,946	85,001	83,977	93,828	103,265	108,564

[1] Figures for 1908–1911 compiled from reports of Deutsche Ammoniak-Verkaufs Vereinigung; figures for 1912–13 compiled from Bradbury and Hirsch's annual review of the market for sulphate of ammonia.

[2] Figures for 1908–1913 compiled from L'Engrais, Jan. 20, 1910, p. 70, and Mar. 13, 1914, p. 296.

[3] Compiled from the American Coal Products Co.'s annual report on the production of sulphate of ammonia.

[4] Annual statement of the trade of the United Kingdom with foreign countries and British possessions.

[5] Difference between production and exports.

In all the important producing countries of Europe, except the United Kingdom, the output of sulphate of ammonia is handled largely through selling agencies. In Germany the Deutsche Ammoniak-Verkaufs-Vereinigung, with headquarters at Bochum, handles the production of Westphalia and the Rhine Province, while the Oberschlesische Kokswerke und Chemische Fabriken A. G., with headquarters at Berlin, handles the output of the Silesian producers.[1] The latter syndicate also includes some producers of Austria-Hungary and is stated to be working harmoniously with the Bochum organization.[2]

In Belgium most of the output of sulphate is handled by one agency, known as the Comptoir Belge du Sulfate d'Ammoniaque, with headquarters at Brussels. In times past this organization has also worked in harmony with the German organization at Bochum.

The output of English producers apparently is not handled by a selling agency, but is sold to consumers through the various merchants and brokers. Sulphate is dealt in on the exchange at Manchester, and the daily quotations of this market have an important influence upon the prices of sulphate in all other countries, since the United Kingdom is the only important exporting country of this fertilizer material.

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[1] L'Engrais, January 31, 1913.

[2] The Chemical Trade Journal and Chemical Engineer, December 27, 1913.

The quantities of sulphate of ammonia exported from the United Kingdom to various countries for the period 1909 to 1914 are shown in Table 13. In 1913 Japan ranked first with more than 114,000 long tons, while the United States ranked fourth with about 37,000 long tons. The figures for the exports to the United States do not agree with the figures for the imports published by the Bureau of Foreign and Domestic Commerce shown on page 45. The latter figures show imports of nearly 43,000 long tons from the United Kingdom in 1913.

TABLE 13.—EXPORTS OF SULPHATE OF AMMONIA FROM UNITED KINGDOM TO PRINCIPAL COUNTRIES BY YEARS. 1909–1913.[1]

Country.	1909	1910	1911	1912	1913	1914
	Gross tons.	*Gross tons.*	*Gross tons.*	*Gross tons.*	*Gross tons.*	*Gross tons.*
Germany	30,495	7,020	2,740	1,643	9,388	3,427
France	11,820	8,432	7,239	7,665	8,874	2,486
Spain and Canaries	60,478	55,617	60,657	66,176	60,852	64,149
Italy	11,008	10,202	10,162	13,542	5,822	5,060
Dutch East Indies	23,027	32,122	28,182	33,535	37,119	54,869
Japan	49,395	57,360	76,095	86,659	114,583	87,776
United States	35,029	76,111	65,920	39,033	36,919	43,601
British West Indies, including Bahamas and British Guiana	12,311	11,707	11,758	8,591	10,012	11,990
Other countries	30,579	25,039	29,130	28,199	39,485	40,519
Total	264,142	283,610	291,883	285,043	323,054	313,877

[1] Compiled from United Kingdom Monthly Trade Returns.

The exports of sulphate of ammonia to the United States from England and Scotland are handled by a number of merchants and brokerage houses located in Glasgow, Liverpool, London, and other centers. The sales are usually made on a c. i. f. basis, Atlantic ports. James Miller & Son Co., of Glasgow, Scotland, is said to be one of the most important, if not the most important, foreign broker or merchant exporting sulphate to the United States. This company is represented exclusively in this country by The Edward J. Walter Co., of Baltimore, Md. Alexander Cross & Sons, also of Glasgow, is another important exporter, but, unlike James Miller & Son Co., has a number of representatives in the United States.

Terms of sale.—Domestic sulphate of ammonia is usually sold in 200-pound bags. Some shipments are made in bulk, especially those on contracts with large fertilizer manufacturers. The price basis for domestic sulphate is 100 pounds, containing 25 per cent of ammonia. No charge is made for excess ammonia, but there is a pro rata reduction if under guaranty. Certificate and settlement are based on net weights f. o. b works. The usual terms are cash, payable in 30 days from date of shipment. The seller furnishes the buyer with an analysis and a duplicate sealed sample taken from each shipment. The buyer has the right to a separate analysis, to be made by a referee chemist selected by him and named in the contract, but he must pay for it if the seller's analysis is sustained.

Foreign sulphate of ammonia is quoted per 100 pounds c. i. f. Atlantic and Gulf ports, subject to foreign invoice weights, tare, and analysis. It is put up in double sacks containing 224 pounds, 10 sacks to the long ton. The sulphate of ammonia imported is the best grade, guaranteed to contain 25 per cent of ammonia. In the United Kingdom the unit is the long ton, and the standard grade is guaranteed to contain 24.5 per cent of ammonia. In 1914, the Sulphate of Ammonia Association in the United Kingdom raised the standard to 25 per cent, due to pressure on the part of the consumer and competition with German production, which is large in quantity and high in quality.

Sales of foreign sulphate of ammonia are made for both prompt and future deliveries. A prompt shipment is one made on the first steamer sailing after the closing of the contract on which available space can be secured. Contracts for future deliveries are those calling for delivery during a month or series of months after the closing of the contract. Each shipment constitutes a separate sale. The terms of settlement are cash upon presentation of draft with complete foreign documents attached.

Sales of sulphate of ammonia by American Coal Products Co.—Nearly 90 per cent of the total sales of domestic sulphate of ammonia in 1913 was handled by one selling agent, the American Coal Products Co. This company, however, handled only 8 per cent of the imported sulphate, which in 1913 formed about 41 per cent of the total consumption of the United States. The American Coal Products Co. has exclusive contracts with almost all of the domestic producers. Only one domestic by-product coke concern, one gas company, and two chemical concerns sell their product either directly or through fertilizer material brokers. The American Coal Products Co. also has exclusive contracts with the Algoma Steel Corporation (Ltd.), a subsidiary of the Lake Superior Corporation, with a bank of 110 Koppers' ovens at Sault Ste. Marie, Ontario, and with the Montreal Light, Heat, & Power Co. Table 14 shows the sales of domestic sulphate of ammonia by the American Coal Products Co., which are compared with total sales of the domestic material in the United States for the period 1907 to 1913, inclusive.

TABLE 15.—SALES OF DOMESTIC SULPHATE OF AMMONIA, IMPORTS, AND TOTAL SALES, ALSO SALES BY THE AMERICAN COAL PRODUCTS CO., AND PERCENTAGE OF SUCH SALES TO THE TOTAL. BY YEARS, 1907–1913.

Year.	Total sales or shipments in pounds.	Sales through American Coal Products Co.		Sales not made through American Coal Products. Co.	
		Pounds.	Percentage of total.	Pounds.	Percentage of total.
1907	55,251,439	41,509,811	75.1	13,741,628	24.9
1908	54,532,828	38,412,309	70.4	16,120,519	29.6
1909	81,681,527	66,162,037	81,0	15,519,490	19.0
1910	96,372,594	79,990,125	83.0	16,382,469	17.0
1911	87,491,350	69,570,684	79.5	17,920,666	20.5
1912	125,804,386	108,308,459	86.1	17,495,927	13.9
1913	183,450,190	164,020,164	89.4	19,430,026	10.6

[1] Figures are those reported by producers; those reported by the American Coal Products Co. differ slightly.

The sales of domestic sulphate of ammonia by the American Coal Products Co. have ranged from 70.4 per cent of the total in 1908 to 89.4 per cent in 1913, the quantity thus handled increasing from 38,412,309 pounds in 1908 to 164,020,164 pounds in 1913, or more than 325 per cent. The sales not made through the American Coal Products Co. have ranged from 29.6 per cent of the total sales in 1908 to 10.6 per cent in 1913, while the quantity thus sold increased from 16,120,519 pounds in 1908 to 19,430,026 pounds in 1913, or only about 21 per cent.

In Table 15 a comparison is made of the sales reported to the Federal Trade Commission by the American Coal Products Co., including Canadian sulphate, with the total sales of domestic and foreign sulphate, by years, 1907–1913.

TABLE 15.—SALES OF DOMESTIC SULPHATE OF AMMONIA, IMPORTS, AND TOTAL SALES, ALSO SALES BY THE AMERICAN COAL PRODUCTS CO., AND PERCENTAGE OF SUCH SALES TO THE TOTAL, BY YEARS, 1907–1913.

Year.	Sales of domestic sulphate.	Imports of foreign sulphate.	Total sales.	Sales by American Coal Products Co.[1]	Percentage of American Coal Products Co.'s sales to total.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	
1907	55,251,439	70,440,992	125,692,431	41,653,606	33.1
1908	54,532,828	76,475,104	131,007,932	38,395,810	29.3
1909	81,681,527	85,829,334	167,510,861	67,850,457	40.5
1910	96,372,594	184,686,534	281,059,128	79,896,606	28.4
1911	87,491,350	189,265,797	276,757,147	[2] 74,665,906	27.0
1912	125,804,386	119,084,402	244,888,788	[2] 118,832,166	48.5
1913	183,450,190	130,550,031	314,000,221	[2] 175,013,713	55.7

[1] These figures reported by the American Coal Products Co. differ somewhat from those furnished by producers.

[2] Includes Canadian sulphate: 1911, 5,197,483 pounds; 1912, 10,292,276 pounds; 1913, 10,724,414 pounds.

In 1911 the American Coal Products Co. handled 27 per cent and in 1913 nearly 56 per cent of the total sales of sulphate of ammonia in the United States. The increase of 1913 over 1911 was more than 100,000,000 pounds. For the four years prior to 1911 the percentage of sales by the American Coal Products Co. to the total sales fluctuated somewhat, the highest being 40.5 per cent in 1909 and the lowest 28.4 per cent in 1910.

The contracts of the American Coal Products Co. with the various by-product coke-oven concerns producing sulphate of ammonia cover the sale of whatever ammonia liquor is produced. Similar contracts have been made with other by-product concerns and various gas companies producing only ammonia liquor. As a result of these exclusive contracts the American Coal Products Co. controls the sale of more than 60 per cent of the commercial production of ammonia liquor, which, with its sales of actual sulphate, gives it control of about 78 per cent of the total domestic sales of ammonia expressed as sulphate equivalent.

Corporate organization of American Coal Products Co.—The American Coal Products Co. was incorporated February 6, 1903, in New Jersey, under a perpetual charter conferring very general powers. Its principal place of business is in New York City. The authorized capital stock of this company consists of $15,000,000 common and $5,000,000 7 per cent cumulative preferred. There were outstanding December 31, 1914, $10,726,700 common and $2,500,000 preferred, and also three-year notes amounting to $2,000,000 and bonds of subsidiaries amounting to $2,670,000.

Among the general powers conferred by the charter in addition to special authority to deal in coke-oven by-products are those authorizing the company to purchase, construct, and operate coke ovens and gas works, purchase and sell all kinds of fuel, to acquire and hold bonds, stocks, and other securities, and to sell or pledge the same. The minutes of the first meeting show that the company was organized for the purpose, among others, of acquiring and holding the stocks, bonds, and other indebtedness of the Barrett Manufacturing Co.[1] and the United Coke & Gas Co.

In taking over the United Coke & Gas Co., in 1903, the American Coal Products Co. obtained the patents and other rights of this company in the Otto-Hoffman and United-Otto systems of coking. It also acquired control of the Pittsburgh Gas & Coke Co., of Pennsylvania; the Otto Coke & Chemical Co. (West Virginia); and the McKeesport Gas Improvement Co. (Pennsylvania), all three being subsidiaries of the United Coke & Gas Co., and also the following companies owned by the McKeesport Gas Improvement Co.: Versailles Gas Co., Duquesne Borough Gas Co., Christie Park Gas Co., Boston Gas Co., and Appliance Gas Co.

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[1] The Barrett Manufacturing Co. is a West Virginia corporation, with $4,807,000 capital stock outstanding, of which the American Coal Products Co. owns $4,799,500. This company manufactures roofing and building papers of all kinds, roofing and paving pitch, tarvia, carbolic acid, benzol, naphtha, and other coal-tar products, and has plants to the number of 40 in various parts of the country.

According to Moody's Manual (1914) the American Coal Products Co. in 1909 sold its by-product and coke-oven interests represented by the United Coke & Gas Co. to the German-American Coke & Gas Co.,[1] which was organized for the purpose of taking over the by-product coke-oven and other patents comprising the Otto-Hoffman and United-Otto systems of construction.

The American Coal Products Co., through the contracts held by the United Coke & Gas Co. and its subsidiaries, and contracts made directly with all the other owners or operators of by-product coke ovens producing sulphate of ammonia, except the New England Gas & Coke Co., has secured, as above noted, a virtual monopoly of the trade in domestic sulphate of ammonia.

The contracts taken over from the United Coke & Gas Co. and the Otto Coke & Chemical Co. provide for a commission of 10 per cent on all sales of by-products, including ammonia and its compounds, as compensation for their services as exclusive agents. These contracts were for a long term of years (10 to 15). The rate of commission was understood to cover services as agent and the right to use the Otto-Hoffman and United-Otto processes. This license provides, among other things, that the licensee shall make no sales of by-products (other than gas) at prices less than those offered by the licensors without their approval. The coke ovens themselves are not patentable, and such patents as were held by the United Coke & Gas Co. covered only attachments, many of which were said to be useless.

The contracts which the American Coal Products Co. has made directly with producers are by no means uniform. They extend over periods from 1 to 15 years and provide for commissions ranging from 2½ to 5 per cent. Most of the contracts provide for 3 per cent commissions. One contract contains a guarantee of accounts. The reason assigned by the American Coal Products Co. for the nonuniformity of these contracts is that it made the best terms it could with the producers.

Sales policy of American Coal Products Co.—The American Coal Products Co. disposes of the larger part of the sulphate of ammonia which it controls directly to the fertilizer manufacturers. Surplus quantities, which it is unable to dispose of directly, it sells to wholesalers and retailers, who pay cash for it and resell as principal. Very little is sold through brokers on commission, the policy being, as far as possible, to eliminate the broker. Table 16 shows the sales of the

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[1] The German-American Coke & Gas Co., of New York City, was incorporated in the State of Connecticut, December 28, 1908, with an authorized capital stock of $2,000,000, of which $500,000 was subscribed. The American Coal Products Co. held an important interest in the stock of the German-American Coke & Gas Co. until 1912, when it sold its entire interest and the German-American company subsequently went out of business.

American Coal Products Co. directly to fertilizer and chemical manufacturers, to wholesalers and retailers, and through brokers and the percentage of such sales to the total sales, by years, 1907–1913:

TABLE 16.—TOTAL SALES OF SULPHATE OF AMMONIA BY THE AMERICAN COAL PRODUCTS CO.; QUANTITY SOLD DIRECTLY, THROUGH BROKERS AND TO WHOLESALERS AND RETAILERS; AND PERCENTAGE OF SUCH SALES TO TOTAL, BY YEARS, 1907–1913.

[From figures furnished by the American Coal Products Co.]

Year.	Total sales in pounds.[1]	Sold to fertilizer, chemical, and other manufacturers directly.		Sold through brokers.		Sold to wholesalers and retailers.	
		Pounds.	Per cent of total.	Pounds.	Per cent of total.	Pounds.	Per cent. of total.
1907	41,653,606	25,858,470	62.1	....	....	15,795,136	37.9
1908	38,395,810	25,414,635	66.2	....	....	12,981,175	33.8
1909	67,850,457	49,376,566	72.8	312,241	0.4	18,161,650	26.8
1910	79,896,606	58,626,936	73.4	1,256,569	1.6	20,013,101	25.0
1911	74,665,906	58,856,177	78.8	345,505	.5	15,464,224	20.7
1912	118,832,166	98,337,792	82.8	1,097,453	.9	19,396,921	16.3
1913	175,013,713	140,230,378	80.1	599,010	.4	34,184,325	19.5

[1] Includes 5,197,483 pounds from Canada, 1911; 10,292,276 pounds from Canada, 1912; 10,724,414 pounds from Canada, 1913.

As the table shows, the quantity of sulphate sold by the American Coal Products Co. through brokers is insignificant, there being no sales at all in 1907 and 1908, and in the other years less than 1 per cent except in 1910, when such sales amounted to 1.6 per cent of the total. The quantities sold to wholesalers and retailers increased from 12,981,175 pounds in 1908 to 34,184,325 pounds in 1913, or more than 150 per cent. The percentage of such sales to the total, however, decreased from 37.9 in 1907 to 16.3 in 1912, and rose to 19.5 in 1913.

The most important of the wholesalers purchasing domestic sulphate from the American Coal Products Co. for resale is the partnership of H. J. Baker & Bro., of New York, which also does a large brokerage business in various fertilizer materials. This concern handles more than 80 per cent of the sulphate sold to wholesalers and retailers, which sales are less than 20 per cent of the total made by the American Coal Products Co. Contracts for future delivery of sulphate of ammonia made by H. J. Baker & Bro., and such other merchants and brokers as sell domestic sulphate, usually provide that either foreign or domestic sulphate may be delivered at the option of the seller, and that the domestic sulphate shall be taken f. o. b. the port at which the foreign would have been delivered. Almost all the sales of domestic sulphate made by H. J. Baker & Bro. during the last eight years appear to have been f. o. b. Atlantic ports instead of f. o. b. plant or c. a. f. destination.

Sulphate propaganda.—The American Coal Products Co. spends considerable sums in advertising sulphate of ammonia as a fertilizer material, in giving lectures before schools, clubs, and granges, etc.

In 1914 about $21,000 and in 1913 about $15,500 were expended in this propaganda work. Approximately 80 per cent of these amounts were spent for the salaries, office and traveling expenses of the personnel engaged in this work. The remainder was spent for printing and distributing publications, free distribution of materials, etc. What effect the expenditure of these sums has had upon the use of sulphate of ammonia as a direct fertilizer or on its use by fertilizer manufacturers, who, as a rule, are well informed as to its value, is difficult to determine. The seven largest companies in 1913 used 75,410 tons of sulphate in the manufacture of mixed goods, as against 55,153 tons of nitrate of soda, or 58 per cent of the total estimated consumption for fertilizer purposes. (See p. 173.)

This propaganda work differs from that of the Nitrate Propaganda Association, in that the latter urges the use of nitrate of soda for home mixing and encourages the direct sale to the consumer. Except for experimental purposes, the American Coal Products Co. until recently has sold only in wholesale quantities to manufacturers, brokers, and merchants.

On June 29, 1915, the American Coal Products Co. wrote the Federal Trade Commission in answer to a request for reasons for not pushing the propaganda for the use of sulphate of ammonia by home mixers, as follows:

> An effort has been made for the last two years to introduce sulphate of ammonia by itself either as a direct application or in connection with other fertilizers. It has been necessary to manufacture a special grade for this that was entirely free from moisture to permit of its being readily mixed and worked in agricultural machinery. This grade * * * has been placed on sale at a price not greater than would actually compensate the producer for the extra cost involved in its manufacture and retail handling. In this field it has to meet the competition of nitrate of soda, which is not extensively used by manufacturers of fertilizers because of its deliquescent nature, but is mostly used direct. * * * A further obstacle is the fact that sulphate of ammonia contains 20.75 per cent of nitrogen, whereas nitrate of soda contains but 15.5 per cent. This in itself necessitates a higher price per ton for the sulphate of ammonia, even if the price per unit of nitrogen is the same. The inclination of the farmer is almost invariably toward the lower-priced fertilizer, even though the fact of the higher test is explained to him.

The producers of sulphate of ammonia in the various European countries maintain an active propaganda to increase its consumption for fertilizer purposes, following the example of the nitrate propaganda (see p. 25). The Bochum organization in Germany has established numerous agricultural experiment stations in different parts of the Empire for propaganda work. The English producers of sulphate, although not disposing of their products through a selling agency, have organized an association which carries on a propaganda throughout the United Kingdom to increase the home consumption of sulphate and which also cooperates with foreign representatives for the promotion of this propaganda.

CHAPTER III.

PRODUCTION AND SALE OF ORGANIC AMMONIATES.

Section 1. Introduction.

In this chapter are presented certain facts regarding the production and sale of the principal organic ammoniates used for fertilizer, viz, cottonseed meal, abattoir and proprietary tankage, dried blood, base goods, and fish scrap. These materials are largely of domestic origin. Cottonseed meal is produced by a large number of cotton-oil mills in the Southern States. Abattoir tankage and dried blood are produced by packing and rendering establishments. Proprietary tankages are produced by a few concerns making a specialty of this business. Base goods, i. e., ammoniates from low-grade materials treated with sulphuric acid (see p. 78), are produced by fertilizer manufacturers in connection with the manufacture of acid phosphate. Fish scrap comes from the fish-scrap factories along the Atlantic coast and also from fish canneries.

Section 2. Cottonseed meal.

Cottonseed meal, the most important organic ammoniate used for fertilizer, is a by-product resulting from the extraction of oil from cotton seed. It contains all three of the essential fertilizing elements, its nitrogen content varying, roughly, from 4 to 8 per cent, which is as high as that of some grades of tankage, its phosphoric acid content being about 2.88 per cent and its potash about 1.77 per cent.[1] It is especially suitable as a fertilizer for long-growing crops, such as cotton and tobacco, because its constituents break down more slowly than the inorganic materials and thus supply plant food during the growing season.

Cottonseed meal is also valuable as a stock food on account of its high protein content, which varies according to the locality in which the seed is grown. In Texas and Oklahoma, for example, the protein content of cotton seed is somewhat higher than that of the seed of South Carolina and Georgia. The latter, however, is said to be richer in oil than the former. The average results obtained in laboratory tests of a large number of samples of cottonseed meal produced in the South Atlantic States is shown below:[1]

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[1] The Cotton Plant, United States Department of Agriculture, and Cottonseed Products, by L. L. Lamborn, 1904, p. 152.

Year.	Number of samples.	Moisture.	Oil.	Nitrogen.	Ammonia.	Protein.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1911-12	7,232	7.86	7.74	6.30	7.66	39.38
1912-13	6,765	8.10	7.88	6.14	7.46	38.38
1913-14	9,177	8.50	7.31	6.13	7.45	38.31

Uses of cottonseed meal.—Until within a comparatively recent period cotton seed itself was used extensively for fertilizing purposes, being rotted in composts and spread on the soil. But as a result of its increase in value, due to uses made of the oil, very little, if any, is now used in this manner. Practically all the seed except that retained for planting purposes is sold to the oil mills and converted into the various products.

As already stated, cottonseed meal is used both as a fertilizer and as a stock food. As a fertilizer, especially in the South, it is an important constituent of mixed goods and is even applied to the soil by itself. But its chief use is as a stock food, both in the United States, where the consumption for this purpose is somewhat greater than that for fertilizer, and in the various European countries to which it is exported in important quantities, such as Denmark, Germany, United Kingdom, the Netherlands, and Belgium, in all of which it is used only for feeding. The meal or cake is fed either by itself or mixed with other materials, and is also used as a constituent of many concentrated stock foods now on the market.

Process of manufacture.—The process of extracting the oil from cotton seed and of obtaining the meal as a by-product consists in (1) cleansing the seed, (2) freeing them from linters, (3) cracking the hulls, (4) cooking the meats, and (5) expressing the oil. The seed brought to the mill are first passed through cleaning machinery, which removes all trash, sand, stones, and other foreign substances. The seed are then passed through delinters, where all of the short fibers possible are removed. They are next conveyed to the hulling machines, which are equipped with either knives or plates for grinding the seed and with screens and shakers for separating the hulls from the meats. The hulls are passed to the storage bin and the meats to the crushers, where the oil cells are broken. The usual method is to crush the meats while cold, but in some mills they are heated before crushing. After being crushed the meats go to the cooker, where they are prepared for the hydraulic presses by cooking under steam pressure. They are then wrapped in camel's-hair press cloths and subjected to a pressure of from 3,000 to 5,000 pounds to the square inch. About 300 pounds of oil are expressed from a ton of cotton seed by the more efficient mills.[1] The cakes of meat from which the oil has been pressed are stacked and afterwards cracked or ground into meal by machinery. For the export trade a considerable quantity of loose cake is sold without being cracked or ground, and for domestic stock food cracked cake is frequently used instead of meal.

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[1] Fertilizer Handbook, 1915, p. H6.

There is now in use a new process of extraction by which the hulling and cooking of the meat are obviated, the oil being pressed directly from the delintered seed. The residual undecorticated meal, as it is called, is used entirely as stock food.

Statistics of the industry.—The total number of active cottonseed-oil mills in 1914 was 885, against 870 in 1913, 857 in 1912, and 839 in 1911. In 1870 there were 26 establishments operating, and in 1860 there were only 7. Since 1909 Texas has made a gain of 37 active mills; Oklahoma, 21; Georgia, 10; North Carolina, 13; and Alabama, 15, while Mississippi shows a loss of 19 and Louisiana a loss of 11. The average quantity of seed crushed per establishment in 1914, the heaviest crushing year on record, was 6,531 tons.[2]

More than 50 per cent of the cottonseed meal produced in North Carolina, South Carolina, Georgia, and Alabama is consumed for fertilizer purposes. In the States west of the Mississippi River a much smaller percentage is used in this way, as the bulk of the total output is exported and most of the remainder is sold for stock food. The Bureau of Soils of the Department of Agriculture estimated that of the entire production of cottonseed cake and meal about 33 per cent is used for fertilizer and 67 per cent for stock food.

The Bureau of the Census of the Department of Commerce publishes annually statistics of the production, exportation, and domestic consumption of cottonseed products. For the last four years these figures are considered fairly accurate. For prior years they are partially estimated. On the basis of these figures and the above-mentioned estimate of the Bureau of Soils, Department of Agriculture, Table 17, below, showing the production, exportation, and consumption of cottonseed meal, has been prepared. The quantities of seed crushed for the years 1911–1914 are the figures reported to the Census, and the quantities of meal and cake exported are taken from the Monthly Summary of Commerce and Finance. The remaining figures for cotton seed produced and crushed and for cake and meal produced are estimates made by the Bureau of the Census and published in Bulletin 131 on Cotton Production in 1914. The figures covering the consumption of meal and cake for fertilizer and for food were computed by the Federal Trade Commission. The quantity used for fertilizer was estimated at about 33 per cent of the total production.

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[1] American Fertilizer Handbook, 1914, p. 264.

[2] Report of the Bureau of the Census on cotton production, 1914. Bulletin 131.

TABLE 17.—TONS OF COTTON SEED PRODUCED AND CRUSHED AND THE PRODUCTION, EXPORTATION, AND DOMESTIC CONSUMPTION OF COTTONSEED CAKE AND MEAL, BY YEARS, 1902–1914.[1]

Year.	Cotton seed.			Cake and meal.				
	Produced.	Crushed.	Crushed of produced.	Produced.	Exported.	Domestic consumption.		
						Total.	Food.	Fertilizer.
	Tons.	*Tons.*	*Per cent.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1902	5,092,000	3,269,000	64.2	1,165,000	550,196	614,804	226,804	388,000
1903	4,716,000	3,241,000	68.7	1,156,000	410,175	745,825	360,825	385,000
1904	6,427,000	3,345,000	52.0	1,360,000	625,954	734,046	281,046	453,000
1905	5,060,000	3,131,000	61.9	1,272,000	555,417	716,583	292,583	424,000
1906	5,913,000	3,844,000	65.0	1,786,000	670,484	1,115,516	520,516	595,000
1907	4,952,000	2,565,000	51.8	1,043,000	464,644	578,356	231,356	347,000
1908	5,904,000	3,670,000	62.2	1,492,000	616,875	875,125	378,125	497,000
1909	4,462,000	3,269,000	73.3	1,326,000	320,044	1,005,956	563,956	442,000
1910	5,175,000	4,106,000	79.3	1,792,000	402,298	1,389,702	792,702	597,000
1911	6,997,000	4,921,073	70.3	2,151,000	646,845	1,504,155	787,155	717,000
1912	6,104,000	4,579,508	75.0	1,999,000	564,046	1,434,954	768,954	666,000
1913	6,305,000	4,847,628	76.9	2,220,000	399,987	1,820,013	1,080,013	740,000
1914	7,186,000	5,779,665	80.4	2,648,000	739,533	1,908,467	1,027,467	881,000

[1] The figures for quantity of seed produced and quantity crushed and cake and meal produced relate to the growth year, while export figures are for the year ending June 30 following.

The estimated production of cake and meal in 1914 was more than twice the production for 1907 and the largest in the history of the industry, when 2,648,000 tons were produced. The exports for 1913 (1914 fiscal year) were the smallest since 1897, except for the year 1909 when only 320,044 net tons were sent abroad, while those for 1914 (1915 fiscal year) were the largest, being 739,533 tons, or more than twice those of 1909. The total domestic consumption has more than trebled since 1907, and during the last two years there has been an even larger gain in the use of meal for feeding purposes. The quantity thus used in 1907 was 231,356 tons and in 1913 and 1914 more than 1,000,000 tons each.

Sale of cottonseed meal.—Cottonseed meal is sold through brokers and in some States is also handled by dealers or jobbers. At Memphis and other centers there are several large concerns which buy and sell cottonseed products for their own account. The mills also sell cottonseed meal directly to consumers. They frequently distribute a considerable proportion of their output in small lots to farmers in their immediate locality for stock food or fertilizer purposes. In the States east of the Mississippi River the farmers frequently exchange their seed for cottonseed meal and fertilizers.

There are cottonseed-meal brokers in practically every important market. In some States they handle a large proportion of the output and in others only a small proportion. . The commission which they receive varies from 10 cents to 25 cents per ton, and is always paid by the mill for which the sale is made. On export business the prevailing commission is 12½ cents per long ton.

The price of cottonseed meal for domestic consumption is usually on a net-ton basis. Sometimes it is sold f. o. b. mill and sometimes c. a. f. destination. Meal sold for export is frequently quoted on a Galveston, New Orleans, or other port basis.

Cottonseed meal is always sold with the ammonia content or protein content guaranteed. In order that either content may be determined, samples are drawn and analyses made. Some of the large mills have their own laboratories for making analyses, and in all the important markets there are chemists who make a specialty of this business.

For the standardization of the product and of the business, and also for the promotion of a propaganda to encourage the consumption of cottonseed meal, various associations of producers have been formed. The most important of these is the Interstate Cotton Seed Crushers' Association with headquarters in Dallas, Tex. This association maintains a publicity bureau which advertises the uses and advantages of cottonseed products, etc. There are also various State associations of cottonseed-meal producers, such as the Texas Cotton Seed Crushers' Association, Arkansas Cotton Seed Crushers' Association, Alabama Cotton Seed Crushers Association, etc.

The official rules governing transactions in cottonseed products, as adopted by the Interstate Cotton Seed Crushers' Association in 1913, provide certain standards for cottonseed-meal transactions to apply in the absence of contracts to the contrary. The short ton is the standard and 100 pounds net the weight of a sack of meal. Cottonseed meal is graded as choice, prime, and good, all of which must be finely ground and of sweet odor, the first two to be free from excess of lint and the second and third reasonably bright in color. The choice grade must be perfectly sound, yellow in color, and must test at least 8 per cent of ammonia, or 49 per cent of combined protein and fat. The prime grade must test at least 7½ per cent of ammonia, or 46 per cent of combined protein and fat; and good cottonseed meal must test at least 7 per cent of ammonia, or 43 per cent of combined protein and fat. Meal not coming up to these requirements is usually sold by sample.

Although the use of cottonseed meal as a food for stock has been gradually increasing, it is probable that the actual tonnage used as a fertilizer material has not materially decreased, due to the fact that the proportion of the cotton seed produced reaching the oil mills is constantly increasing, it being estimated that more than 80 per cent of the 1914 crop reached the oil mills, while in 1907 probably only a little more than 50 per cent was utilized. The difference between the quantity of cotton seed produced and the quantity reaching the mills represents the seed saved for planting purposes and what is known as the invisible supply; that is, seed badly damaged or produced at a point too remote from the mill to pay to ship. The amount of seed necessary for seeding purposes is not more than 5 per cent of the production, but the farmer usually retains considerably more than he needs for fear of damage to the young plants.

Principal producers.—There has been considerable concentration of ownership of cottonseed mills, among the most important companies being the Southern Cotton Oil Co., the American Cotton Oil Co., and the Buckeye Cotton Oil Co. In 1913 these three concerns together operated 139 mills and produced about 500,000 tons of cottonseed meal and cake or nearly 23 per cent of the total production for the United States.

There are several other consolidations of smaller size, among which may be mentioned the Empire Cotton Oil Co., the so-called Ehle Mills, Henson Mills, Bencini Mills, and the Southland Cotton Oil Co.

Southern Cotton Oil Co.—The Southern Cotton Oil Co. was incorporated under the laws of New Jersey in 1887. The capital stock outstanding is $10,000,000. In June, 1901, the Virginia-Carolina Chemical Co. purchased the entire capital stock, and has since controlled it. (See p. 186.) The company is engaged in crushing cotton seed, refining cottonseed oil, and manufacturing lard compounds and other products. It also mixes and sells more than 100,000 tons of fertilizers annually. As shown by Table 18, it has 79 crude-oil mills located in 9 different States, 52 of which are engaged in mixing and selling fertilizers.

TABLE 18.—NUMBER OF CRUDE-OIL MILLS AND DRY-MIXING PLANTS OPERATED BY THE SOUTHERN COTTON OIL CO. IN 1914.

State.	Number of crude-oil mills operated.	Number engaged in mixing fertilizer.	Fertilizer output in 1914.
			Tons.
Georgia	25	21	28,800
South Carolina	19	13	22,100
North Carolina	15	10	24,600
Alabama	11	5	9,400
Mississippi	[1]4	1	3,500
Arkansas	2	1	7,000
Florida	1	1	1,200
Tennessee	1	0	....
Louisiana	1	0	....
Total	79	52	96,600

[1] Operated by the Refuge Cotton Oil Co.

In addition to the above mills, the Southern Cotton Oil Co. has three dry-mixing plants not connected with its cotton-oil mills. These are located at Allendale, Greenville, and Kingstree, S. C., with a combined output in 1914 of 4,500 tons, making the total output of fertilizer for all mills 101,100 tons. For further details regarding the fertilizer business of this company see Chapter VIII, p. 186.

American Cotton Oil Co.—The American Cotton Oil Co. was incorporated in New Jersey in October, 1889. The capital stock outstanding consists of $20,237,100 of common and $10,198,600 of 6 per cent noncumulative preferred, the amount of preferred stock authorized being $14,562,300. There is also a bonded indebtedness of $10,000,000. The company is engaged in crushing cotton seed, refining the oil, and manufacturing various cottonseed products, such as cottonseed oil, cake, meal, hulls, and linters; also such related products as lard compound, refined edible oils, soaps, washing powders, and fertilizers. Its numerous plants for manufacturing these products are located in 16 States.

The business of crushing seed, ginning and manufacturing fertilizers has been largely taken over by one subsidiary of the American Cotton Oil Co., known as the Union Seed & Fertilizer Co., which now transacts the business formerly carried on by the following companies:

Alabama Cotton Oil Co.
Arkansas Cotton Oil Co.
Georgia Cotton Oil Co.
Mississippi Cotton Oil Co.
New Orleans Acid & Fertilizer Co.
North Carolina Cotton Oil Co.
South Carolina Cotton Oil Co.
Tennessee Cotton Oil Co.
Capital Fertilizer & Manufacturing Co.
R. B. Brown Oil Co.

These companies have either been dissolved or are in process of dissolution. The American Cotton Oil Co. prior to June, 1914, also controlled the Industrial Cotton Oil Co., with several mills in Texas. The latter company has been taken over by the Industrial Cotton Oil Properties, a Massachusetts concern. The American Cotton Oil Co. owns all of the bonds of this concern, but none of the stock.

Table 19 shows the number of crude oil mills operated in each State by the American Cotton Oil Co. and also the number of fertilizer plants connected with the oil mills.

TABLE 19.—CRUDE-OIL MILLS AND NUMBER OF MILLS ENGAGED IN MIXING FERTILIZER OPERATED BY THE AMERICAN COTTON OIL CO.

State.	Owned in 1913–14.	In operation 1913–14.	Selling fertilizer.
Alabama	6	5	2
Arkansas	8	6	1
Georgia	12	9	6
Mississippi	10	5	....
North Carolina	4	4	4
South Carolina	2	2	1
Tennessee	4	4	1
Missouri	1	1	....
Total	47	36	15

In addition to the 15 cotton-oil mills which are engaged in the manufacture and sale of fertilizers, the company has three additional fertilizer plants not connected with its cotton mills. The Union Seed & Fertilizer Co., successor to the New Orleans Acid & Fertilizer Co., and the Capital Fertilizer Manufacturing Co. operates a wet-mixing plant at Gretna, La., near New Orleans, a dry-mixing plant at Jackson, Miss.; and the Latta Gin & Manufacturing Co. in 1913 operated a dry-mixing plant at Latta, S. C.

Buckeye Cotton Oil Co.—The Buckeye Cotton Oil Co. is a subsidiary of The Proctor & Gamble Co., large soap manufacturers with headquarters at Cincinnati, Ohio. Its capital stock authorized and outstanding, consists of $200,000 common and $50,000 preferred. It has no bonded indebtedness. It operates 12 mills as follows: Four in Georgia; three in Alabama; two in Mississippi; and one each in Arkansas, Tennessee, and North Carolina. These mills have an aggregate of 121 presses, and in 1913–14 had a combined output of 130,856 tons, which places the company third in point of size. It does not make or handle any mixed fertilizer.

Other companies.—The Empire Cotton Oil Co. was incorporated under the laws of Delaware in May, 1912. Its capital stock outstanding consists of $1,215,000 common and $1,250,000 preferred stock, $2,000,000 of each being authorized. It has no bonded indebtedness. This corporation has taken over 11 cotton-oil companies, all of which are situated in Georgia and all but one of which are in operation. They are as follows:

Bainbridge Oil Co.
Valdosta Oil Co.
Quitman Oil Co.
Vienna Cotton Oil Co.
Laurens Cotton Oil Co.
Atlanta Oil & Fertilizer Co.
North Georgia Fertilizer Co.
Telfair Fertilizer Co.
Monticello Oil Co.
Madison Oil Co.
Central Oil and Fertilizer Co.

In 1913 this company produced 26,191 tons of cottonseed meal, of which 21,087 were sold for domestic consumption and 4,993 used in the manufacture of fertilizers. Its sales of bagged fertilizer in that year amounted to about 32,000 tons.

The "Henson Mills" is an aggregation of eight separate cotton-oil corporations, one ginning, and one tank-line company, all having their general office at Chattanooga, Tenn. The total paid-up capital stock of the eight cotton-oil companies is $1,850,000. None of the concerns have any bonded indebtedness. The Henson Mills itself is not an incorporated body, the eight corporations being held together through interownership of stock and interholding of administrative offices and directorships. Eighteen cotton-oil mills are operated by these companies in six different States, as follows:

Osage Cotton Oil Co., Oklahoma, 8; Arkansas, 2.
Jacksonville Cotton Oil Co., Texas, 1.
Florida Cotton Oil Co., Florida, 2.
Sallisaw Cotton Oil Co., Oklahoma, 1.
Athens Cotton Oil Co., Texas, 1.
Epes Cotton Oil Co., Alabama, 1.
Kaufman Cotton Oil Co., Texas, 1.
Bastrop Cotton Oil Co., Louisiana, 1.

The Henson concern, therefore, has nine mills in Oklahoma, three in Texas, two in Arkansas, two in Florida, and one each in Alabama and Louisiana. Only one oil refinery is operated, this being in connection with one of the Florida mills. In addition, this concern operates the Florida Tank Line Co., Jacksonville, Fla., for shipping cotton oil, and the Planters' Cotton & Ginning Co., Muskogee, Okla., which owns and operates gins only. The paid-up capital stock of this latter concern is reported as only $2,600. Of the authorized capitalization, 955 shares are held by a trust company as trustee.

For the year ending May 31, 1914, the mills of this concern operated 80 presses and produced 53,695 tons of cottonseed meal, practically all of which was sold for cattle food. None of them now manufactures fertilizers, although the Florida Cotton Oil Co. until recently operated a small fertilizer plant in connection with its mill at Jacksonville. The cotton oil produced by the mills is sold through the general office at Chattanooga, Tenn., but each company disposes of its own cottonseed meal.

Of the Henson Mills organization, the Osage Cotton Oil Co. is the most important, its paid-up capital being $1,238,600, or 67 per cent of the total. For the fiscal year ending May 31, 1914, it operated 42 presses and produced 27,995 tons of cottonseed meal, or more than 50 per cent of the total output of the 18 Henson mills.

Another group of mills comprises those operated by C. H. Bencini, Fort Worth, Tex., who manufactures and exports cottonseed products. There are eight mills, all in the State of Texas, which together operate 32 presses, and during the fiscal year 1913–14 produced 15,719 tons of cottonseed meal and cake, and in 1914–15, 27,378 tons. None of these mills manufacture fertilizers. About 60 per cent of the meal and cake is exported and the remaining 40 per cent is consumed in the United States as cattle food.

The so-called Ehle group of cotton-oil mills includes 10 mills in Texas, 3 in Arkansas, and 1 in Tennessee, which were conveyed June 14, 1914, as follows:

Texas:	Conveyed to:
Alvarado Oil Mill.	Robert C. Bonham.
Fort Worth Oil Mill.	Edward Tilden.
Gatesville Oil Mill.	Edward Tilden.
Greenville Oil Mill.	Charles A. Alling.
Grandview Oil Mill.	Charles A. Alling.
Houston Oil Mill.	Edward Tilden.
Itasca Oil Mill.	Edward Tilden.
Temple Oil Mill.	Robert C. Bonham.
Waco Oil Mill.	Edward Tilden.
West Oil Mill.	Edward Tilden.
Arkansas:	
Forest City Oil Mill.	Charles A. Alling.
Little Rock Oil Mill.	Edward Tilden.
Pine Bluff Oil Mill.	Charles A. Alling.
Tennessee:	
Shelby County Cotton Oil Mill, Memphis.	Edward Tilden.

These mills, which have a combined capitalization of more than $2,500,000, are owned severally by Armour, Swift, and Morris interests. The title to them, when acquired, was taken in the name of Louis C. Ehle, an attorney in Chicago. In March, 1914, he transferred title to Francis W. Dewson, a mill operator with an office in Chicago, and in June, 1914, Dewson transferred title to three persons, viz, Edward Tilden, representing Swift interests; Robert C. Bonham, representing Armour interests; and Charles A. Alling, representing Morris interests. In 1914 the State of Texas brought suit against the owners of these mills for violation of the State antitrust law. Details regarding this alleged conspiracy in restraint of trade are given on page 65.

Morris interests also own the following group of oil mills located in Texas:

Alamo Oil & Refining Co., San Antonio, Tex.
San Antonio Mill, San Antonio, Tex.
Brady Oil Mill, Brady, Tex.
Brownwood Oil Mill, Brownwood, Tex.
Coleman Oil Mill, Coleman, Tex.
Dublin Oil Mill, Dublin, Tex.
Goldthwaite Oil Mill, Goldthwaite, Tex.
Hamilton Oil Mill, Hamilton, Tex.
Hico Oil Mill, Hico, Tex.
Stephensville Oil Mill, Stephensville, Tex.

Swift & Co. own two oil mills, one at Atlanta, Ga., and the other at Columbia, S. C.

The Southland Cotton Oil Co., with headquarters at Paris, Tex., is a combination of 10 mills. It was incorporated in Texas in 1914 with a capitalization of $1,250,000 as successor to the Continental Cotton Oil Co., of New Jersey. Mills are operated by the new corporation at the following places: Paris, Tex.; Decatur, Tex.; Waxahachie, Tex.; Corsicana, Tex.; Temple, Tex.; Oklahoma City, Okla.; Chandler, Okla.; Wynnewood, Okla.; Shreveport, La.; Jackson, Miss.

The total number of presses operated by these mills is 58. The total production of meal and cake in the 1914–15 season was 38,413 tons, most of which was exported or sold for stock food in this country.

Agreements in restraint of trade.—The competition of oil mills for the cotton seed used, according to statements of mill operators, has frequently resulted in bidding up prices to an unprofitable level. In consequence, it appears that several attempts have been made by oil mills to control the prices of cotton seed by secret agreement. These agreements have generally been of a local character. In 1914, however, proceedings were brought by the Attorney General of Mississippi against a large number of mills located in Mississippi and adjoining States for conspiracy to control the price of seed. The evidence collected in these proceedings indicated the existence of a combination embracing all the mills in Mississippi and numerous mills in adjoining States. Many of these mills were members of the Sons of Plato, a so-called social organization, at whose meetings the plans for conducting the combination were formulated and discussed. These plans were then carried out through the agency of a statistical bureau, which apportioned the quantity of seed used by members, fixed the price to be paid, imposed penalties, etc. The mills reported to the statistical bureau each week during the crushing season the quantity of seed purchased and the bureau sent out at frequent intervals the prices to be paid for seed in each locality. The head of the statistical bureau for many years was E. M. Durham, president of the Refuge Cotton Oil Co., a subsidiary of the Southern Cotton Oil Co., which in turn is owned by the Virginia-Carolina Chemical Co.

In the suit brought by the State of Texas against the so-called Ehle mills it was charged that Swift & Co., of Illinois; Armour & Co., of Illinois; and Morris & Co., of Maine, entered into a combination and conspiracy (1) to restrain trade and commerce in the purchase of cotton seed and the sale of cottonseed products throughout the United States; (2) to fix and maintain the price of cotton seed and cottonseed products throughout the United States; (3) to prevent and lessen competition in the purchase of cotton seed and cottonseed oil, in the manufacture of the oil and other products, and in the sale of these products throughout the United States; (4) to fix and maintain a standard and figure by which the price of cotton seed, oil, and other products are affected, controlled, and established throughout the United States; and (5) to pool, combine, and unite their respective interests in the purchase of cotton seed and oil, in the manufacture of the various products and the sale of them throughout the United States. The case was recently settled by agreed judgment. The State of Texas received $40,000 as penalties and the three companies were permanently enjoined from jointly operating oil-mill properties in Texas as well as from severally engaging in the cotton oil-mill business in that State. Three trustees were appointed to superintend the three groups of properties until they are sold.

Section 3. Tankage and dried blood.

A number of animal ammoniates used for fertilizer purposes are produced by slaughtering establishments from their waste products, and also by rendering establishments from dead animals and meat scraps. Of these, tankage and dried blood are the most important. Bone meal, hoof meal, horn meal, and other lower-grade ammoniates are also produced by the same concerns.

Dried blood, as prepared for fertilizer, is a dark reddish meal or powder containing about 17 per cent of ammonia, equivalent to about 14 per cent of nitrogen. When applied to the soil it decomposes readily, releasing ammonia, which is absorbed by plants or converted into nitrates by soil acids. The rapidity of decomposition depends upon such factors as the character of the soil, temperature, etc. It has a high fertilizer value.

Tankage is a meal of brownish color and strong odor. There are various grades, depending largely upon the proportion of flesh and bones used. The standard high-grade tankage in the Chicago market contains from 9½ to 11 per cent of ammonia (7.8 to 9.0 per cent of nitrogen) and from 12 to 20 per cent of bone phosphate of lime. Lower grades of tankage contain less ammonia and more bone phosphate. When mixed with the soil tankage decomposes more slowly than dried blood, so that it furnishes food to plants over a longer period.

A large variety of waste materials, such as leather scraps and fleshings, hair, fur, feathers, felt, discarded printing press rollers, etc., are utilized by a number of concerns in making so-called tankages, which are usually sold under special brands or names. Some of these materials are also used directly by fertilizer manufacturers in making base goods. The production and sale of these materials are discussed in more detail in Section 4, page 76.

Process of production.—Dried blood is prepared by coagulating, drying, and grinding. The blood flowing from the slaughtered animals is conveyed as soon as possible into vats where it is heated by means of steam until coagulated. It is then placed in press cloths and as much moisture as possible is extracted in high-power presses, after which it is passed through hot-air driers until the moisture remaining constitutes but 5 to 10 per cent of the weight. The grinding process consists in passing the material through a cage mill which breaks up the small lumps, so that the whole mass is in suitable condition for fertilizer purposes. Many abattoirs do not have facilities for preparing dried blood, and at such plants the blood is run in with the tankage.

Tankage is produced from meat scraps, intestines, bones, carcasses of dead and condemned animals, etc., by cooking in specially constructed tanks, under steam pressure of about 40 pounds, for from 4 to 12 hours, the average time being from 6 to 8 hours. After most of the grease and tallow have been removed from the cooked mass, the solid material is separated from the tank water and dried and ground. Tankage thus prepared still contains, as a rule, from 10 to 20 per cent of grease, which it has been found profitable to extract before using for fertilizer. A number of concerns are engaged in making this extraction, naphtha being used as the degreasing agent.

Formerly, the tank water above mentioned was allowed to go to waste by running into the sewer, but it is now collected into vacuum pans or evaporators and reduced to the consistency of molasses. In this form it is known as "stick." It is then either mixed with tankage and dried or is dried by itself on large hot rollers, in which case it is called concentrated tankage, or "dried stick." The ammonia content of this material ranges from 14 to 15 per cent, but, on account of its unstable mechanical condition and the difficulties encountered in handling, it is not considered by some manufacturers as desirable for fertilizer as tankage and dried blood. In warm weather it is apt to become a sticky mass, difficult to mix with acid phosphate and other materials. Sulphate of iron is usually mixed with the "stick" to prevent this deliquescence.

Producers.—The largest producers of tankage and dried blood in the United States are the Armour Fertilizer Works, Swift & Co., Morris & Co., Sulzberger & Sons Co., and The Cudahy Packing Co. The Armour Fertilizer Works is owned by the stockholders of Armour & Co., one of the five largest packers. This company takes the offal from the abattoirs of Armour & Co. and manufactures tankage, dried blood, and other products from it. These five large packing concerns have their headquarters in Chicago, but operate abattoirs in various western centers. Four of them also have abattoirs in New York. The location of the principal abattoirs of these concerns is shown in Table 20.

TABLE 20.—LOCATION OF THE PRINCIPAL ABATTOIRS OF THE FIVE LARGEST PACKING COMPANIES.

Swift & Co.	Armour & Co.	Morris & Co.	Sulzberger & Sons Co.	The Cudahy Packing Co.
Chicago, Ill.	Chicago, Ill.	Chicago, Ill.	Chicago, Ill.	Wichita, Kans.
New York, N. Y.	New York, N. Y.	New York, N. Y.	New York, N. Y.	Los Angeles, Cal.
East St. Louis, Ill.	East St. Louis, Ill.	East St. Louis, Ill.	Los Angeles, Cal.	Kansas City, Kans.
Kansas City, Kans.	Kansas City, Kans.	Kansas City, Kans.	Kansas City, Kans.	South Omaha, Nebr.
South Omaha, Nebr.	South Omaha, Nebr.	South Omaha, Nebr.	Oklahoma City, Okla.	Sioux City, Iowa.
South St. Joseph, Mo.	South St. Joseph, Mo	St. Joseph, Mo.	Sioux Falls, S. D.	
South St. Paul, Minn.	Sioux City, Iowa.	Oklahoma City, Okla.		
Denver, Colo.	Denver, Colo.			
St. Louis, Mo.	Fort Worth, Tex.			
Cleveland, Ohio.				
Milwaukee, Wis.				
Harrisburg, Pa.				
Harrison, N. J.				
Fort Worth, Tex.				

Both Armour & Co. and Swift & Co. operate abattoirs in Canada. These two companies, together with Morris & Co. and Sulzberger & Sons Co., are also engaged in Argentina in preparing meats for export. Swift & Co. have two establishments in South America—one at La Plata, Argentina, and the other at Montevideo, Uruguay. The latter has two branches in Patagonia. Armour & Co. and Morris & Co. together own one abattoir at La Blanca, Argentina, and Armour & Co. have recently completed a new plant at La Plata. Sulzberger & Sons Co. operate a plant under lease in Argentina. According to statements made by these companies, they do not, as a rule, import blood and tankage direct from their plants in Argentina, but dispose of their output to brokers and speculators, particularly in England. A large proportion of the tankage which comes to the United States from Europe is said to originate in Argentina.

Other important packers in the United States who produce dried blood and tankage are Kingan & Co. (Ltd.), with two packing establishments at Indianapolis, Ind., and one at Richmond, Va.; T. M. Sinclair & Co. (Ltd.), Cedar Rapids, Iowa; John Morrell & Co., with plants at Ottumwa, Iowa, and Sioux Falls, S. Dak., and a branch office in Chicago, which handles the fertilizer by-products; the Jacob Dold Packing Co., with plants at Buffalo, N. Y., Kansas City, Mo., and Wichita, Kans.; the Cleveland Provision Co., Cleveland, Ohio; the Pittsburg Provision & Packing Co., Pittsburgh, Pa.; Cudahy Bros., Milwaukee, Wis.; and the D. B. Martin Co., with abattoirs at Baltimore, Md., Wilmington, Del., and Philadelphia, Pa.

Important rendering concerns producing tankage are the Globe Rendering Co., of Chicago, Ill., controlled by Morris interests, which operates, through subsidiaries, plants at East St. Louis, Ill.; Kansas City, Kans.; New Orleans, La., and Oklahoma City, Okla.; Darling & Co., Chicago, Ill., also controlled by Morris interests, engaged in rendering, degreasing, and also manufacturing fertilizers, and the Consolidated Rendering Co., of Boston, Mass., which, through subsidiaries, operates numerous rendering plants in New England and New York and also makes complete fertilizers at Lowell, Mass., Syracuse, N. Y., and other points. (See p. 210.) This company is controlled by Swift interests.

Several large fertilizer manufacturers also operate rendering establishments in the United States. The American Agricultural Chemical Co. has one at Buffalo and another at Brooklyn, N. Y., and also owns several subsidiaries engaged in rendering, degreasing, manufacturing glue, etc., with plants at Portsmouth, N. H.; Newark, N. J.; Toledo, Ohio; and Ecorse, Mich. The International Agricultural Corporation operates a rendering plant at Buffalo, N. Y., and Baugh & Sons Co. conduct a similar establishment at Philadelphia, Pa.

Purchases by producers.—Two Chicago concerns, the Armour Fertilizer Works and Swift & Co., not only manufacture tankage and dried blood, but purchase these materials, particularly tankage, from small abattoirs and rendering concerns throughout the country, many of which do not have facilities for grinding their product and for producing a strictly high-grade material. These concerns ship the material thus purchased either to Chicago or to their nearest large packing house, where it is degreased, ground, and mixed with concentrated tankage to bring it up to standard grade, or is shipped direct to one of their numerous fertilizer plants in the South.

Imports of tankage and dried blood.—Considerable quantities of tankage, dried blood, and other fertilizer materials obtained from slaughtering establishments are imported into the United States each year from Europe, Argentina, Australia, and other countries. Figures published by the Bureau of Foreign and Domestic Commerce show the value of the imports of dried blood, but not the tonnage. For the fiscal year 1911 the value was $446,698; for 1912, $215,255; for 1913, $80,145; for 1914, $391,816.[1] In the statistics of imports of the above-mentioned bureau, nitrogenous manures, including foreign tankage, are combined with some other fertilizer materials under the general heading, "Substances used only for manures," so that it is impossible to ascertain the quantities imported.

The large packers state that they do not themselves import tankage and blood, but two of them purchase some foreign material from importers for their own use. Armour and Swift both use some foreign tankage in their fertilizers, but state that except for a small quantity coming from Canada they do not always know where their foreign purchases originate, as that coming from Germany and England, for example, may have been bought from some speculator who secured the material in Argentina.

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[1] Commerce and Navigation, 1914.

Storage facilities.—The storage capacity for the output of fertilizer by-products at many of the small abattoirs is limited to a carload or two or to a month's output. Such concerns usually sell their output on contracts extending over a period of six months to a year and ship at stated intervals, or as fast as it is produced. The large packers, especially those operating fertilizer plants, have practically unlimited facilities for storage of fertilizer by-products. Both the Armour Fertilizer Works and Swift & Co. have a large number of fertilizer plants scattered throughout the South. The Morris Fertilizer Co., a subsidiary of Morris & Co., has two large fertilizer plants, one at Atlanta, Ga., and the other at Montgomery, Ala. The Cudahy Packing Co. has a storehouse at Charleston, S. C., at which large stocks, particularly of "cattle tankage" (6½ and 30 per cent), are accumulated during the dull season. Sulzberger & Sons Co. had one large fertilizer factory at Baltimore, operated by the United States Fertilizer Co., which was burned in 1914.

Estimated domestic production.—In the absence of accurate statistics of the domestic production of tankage and dried blood the Federal Trade Commission has undertaken to make an estimate of the total production based on the slaughter of the different classes of animals and the quantity recovered per head for each class.

All of the packers consulted, as well as the Bureau of Animal Industry, Department of Agriculture, agree that the tankage and blood are saved from the total slaughter under Federal inspection and also from one-third to one-half of the commercial slaughter which is not under Federal inspection, and that none is saved from the animals slaughtered on farms. On this point Mr. F. S. Lodge, chemist of the Armour Fertilizer Works, Chicago, Ill., makes the following statements:

> * * * As to the method of arriving at the production, we believe that none of the fertilizer material is saved from animals slaughtered on the farm, and that all is saved from the Federally inspected slaughter. As to the retail commercial slaughter we think that the estimate of 50 per cent being saved is too high. The small town butcher who slaughters only once or twice a week saves none of his tankage and blood, and it is only in slaughterhouses killing daily, such as as are found in towns of several thousand inhabitants, that they make attempts to save this material. * * *
>
> We find that even if the smaller slaughterhouses do attempt to save some of their materials their efficiency is very low, that they very seldom save any concentrated tankage and only a small proportion of the blood, and only such tankage and bone as would be obtained from their rendering tanks, the intestines, pecks, stomachs, and other organs not containing fat being discarded. * * *
>
> We would estimate that not more than one-third of this retail commercial slaughter should be considered as having the fertilizer products saved.

On the basis of the Federally inspected slaughter,[1] plus one-third of the commercial slaughter not under Federal inspection,[2] the total slaughter from which the fertilizer products were saved for the fiscal years 1910 to 1914 is estimated as follows:

Year.	Cattle.	Calves.	Sheep and goats.	Swine.
1910	9,575,697	3,404,809	12,184,476	29,271,554
1911	9,346,065	3,283,683	14,097,102	31,581,722
1912	9,036,232	3,309,629	15,421,008	36,991,031
1913	8,582,767	3,104,787	15,960,926	34,169,895
1914	8,079,447	2,689,051	16,302,082	35,227,411

The amount of blood and tankage recovered per head by the different packers varies considerably with the equipment and efficiency of their establishments. The figures furnished the Federal Trade Commission show wide variation in yield. Those of the Armour Fertilizer Works appear to be the most representative, being based on tests covering all of their plants for a good many years.[3] Mr. Lodge's statement regarding this matter is as follows:

> The different methods in vogue must of necessity cause some variation in the yield, but on the average we figure that by good practice the following yields per head should be obtained:

Fertilizer material.	Cattle.	Calves.	Sheep.	Goats.	Swine.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Tankage (10 per cent moisture basis)	12	2.4	1.2	1.2	4.8
Blood (10 per cent moisture basis)	7	.75	.5	.5	1.2
Concentrated tankage (5 per cent moisture, 10 per cent copperas, 14.5 per cent ammonia)	6	1.2	.6	.6	2.4

> The tankage in this case contains such bone only as would normally be present, running probably 5 per cent of bone phosphate of lime.

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[1] The ante mortem inspection of animals by species slaughtered under Federal inspection for the fiscal years 1910 to 1914, as shown by the annual reports of the Bureau of Animal Industry, Department of Agriculture, is as follows:

Slaughter of food animals under Federal inspection by species, fiscal years, 1910–1914.

Year.	Cattle.	Calves.	Sheep.	Goats.	Swine.
1910	7,999,547	2,295,800	11,164,635	116,063	27,731,627
1911	7,807,712	2,214,127	13,005,822	54,382	29,920,261
1912	7,548,877	2,231,622	14,222,125	64,102	35,044,995
1913	7,170,052	2,093,501	14,730,915	56,569	32,372,275
1914	6,749,578	1,813,178	14,974,144	122,345	33,374,156

Attention is called to the decline in the slaughter of cattle under Federal inspection, which fell 1,249,969, from 7,999,547 in 1910 to 6,749,578 in 1914, or more than 15 per cent. This was largely offset, however, by the steady increase that has taken place in the slaughter of sheep and swine, which in 1914 was 3,809,509 and 5,642,529 greater, respectively, than in 1910.

[2] The commercial slaughter not under Federal inspection is obtained by deducting the Federally inspected slaughter given in footnote 1 from the total commercial slaughter. The latter is estimated by using the percentages of the Federally inspected slaughter for each class of animals to the total commercial slaughter in the United States as reported by the Census for the year 1909 and applying them to the Federally inspected slaughter for the fiscal years 1910–1914, shown in footnote 1. The percentages are as follows: Cattle, 62.85; calves, 40.83; sheep, 80.86; goats, 62.85; and swine, 85.72. See Twenty-eighth Annual Report of the Bureau of Animal Industry, Slaughter and Consumption of Food Animals for the year 1909, p. 254.

[3] The yields for the commercial slaughter are not more than 75 per cent of the above figures. But as Mr. Lodge's estimate of one-third is rather conservative the yields given by him are used for the total slaughter from which by-products are saved.

On the basis of these yields the estimated total production during the fiscal year 1914 would be 146,031 tons of tankage, containing 10.5 per cent of ammonia; 54,498 tons of dried blood, containing 16.5 per cent of ammonia; and 73,015 tons of concentrated tankage, containing 14.5 per cent of ammonia.

Not more than 75 per cent of the dried blood and 25 per cent of the concentrated tankage are manufactured for use as such, the balance of these two products going into tankage. The actual production of tankage is, therefore, increased, while that of dried blood and concentrated tankage is diminished, with the following results:

	Tons.
High-grade tankage, 10.5 per cent ammonia	146, 031
13,625 tons of dried blood, containing 16.5 per cent of ammonia, equals tankage containing 10.5 per cent ammonia to the amount of	21, 410
54,761 tons concentrated, containing 14.5 per cent ammonia, equals tankage containing 10.5 per cent ammonia to the amount	75, 623
Total tankage	243, 064
Dried blood actually produced	40, 874
Concentrated tankage actually produced	18, 254

On the same basis, the following estimated production of abattoir tankage, dried blood, and concentrated tankage has been computed for the fiscal years 1910–1914:

Year.	Tankage.	Dried blood.	Concentrated tankage.
	Tons.	*Tons.*	*Tons.*
1910	232, 902	41, 551	17, 388
1911	241, 146	42, 312	18, 034
1912	260, 266	44, 188	19, 528
1913	244, 712	41, 772	18, 351
1914	243, 064	40, 874	18, 254

Production and purchases of large packers.—In 1913 the five large packers having headquarters in Chicago produced 27,486 tons of dried blood or nearly 66 per cent of the total estimated production of 41,772 tons and 79,177 tons of tankage or more than 32 per cent of the total estimated production of 244,712 tons. Two of the five concerns purchased 7,986 tons of blood and 49,606 tons of tankage, making the total quantity handled by the five concerns 128,783 tons of tankage and 35,472 tons of dried blood. These purchases include some foreign material, amounting to not more than 10 per cent of the total purchases. After making allowance for such purchases it is found that the five large packers handled approximately 50 per cent of the domestic output of tankage and about 83 per cent of the domestic output of blood.

Uses.—The greater part of the production of dried blood and tankage and all of the concentrated tankage are used by the manufacturers of mixed fertilizers as a source of ammonia. Some tankage, especially that high in bone phosphate of lime, such as "Cudahy's cattle tankage," which contains 6½ per cent of ammonia and 30 per cent of bone phosphate of lime, is sold in important quantities direct to truckers, citrus-fruit growers, and sugar planters, who do their own mixing or apply it directly to the soil. Swift & Co. have had an extensive trade in a similar grade of tankage with Louisiana sugar planters. Concentrated tankage formerly was used to a slight extent as a retarder in cement and concrete, but for the last few years certain chemicals have displaced its use for this purpose.

The use of tankage as food for hogs has grown in recent years to such an extent that to-day all of the five large packers, as well as several others, are engaged in preparing animal foods from selected tankage. Swift & Co. were the pioneers and were soon followed by Armour & Co. Morris & Co., Sulzberger & Sons Co., and The Cudahy Packing Co. have only recently started the manufacture of hog food. Cudahy, the last to engage, started in July, 1913. The production of animal foods by packing-houses from their by-products and by rendering establishments for the year 1913 as reported by 10 concerns amounted to more than 40,000 tons. This figure includes poultry food, which is usually made from suet, meat scraps, shop fats, etc., after the tallow and grease have been extracted, and also a small quantity of calf food, which is made largely from dried blood. Hog food is sold under various names, such as "meat meal," "digester tankage," "high protein meal," etc., and is guaranteed to contain a certain quantity of protein, ranging from 40 per cent in some makes to 60 per cent in others. The importance of this animal food industry is illustrated by the fact that during 1913 Swift & Co. produced a greater quantity of animal foods than they did of tankage.

In order to determine the quantity of tankage sold for fertilizer, there should be deducted from the total production such tankage as enters into animal food. The total production of animal food from selected tankage, meat scraps, etc., during 1913 is estimated at approximately 50,000 tons. Probably not more than two-thirds of this quantity was actually made from slaughterhouse tankage, the balance coming from meat scraps, trimmings, shop fats, suet, etc., gathered from butcher shops and small slaughtering establishments. Hog food made from tankage is usually sold on a guarantee of 60 per cent protein content, equivalent to about 12 per cent of ammonia content. However, some hog food is sold on a guarantee of 40 per cent of protein content, and poultry foods range from 25 to 50 per cent in protein content. Allowing 34,000 tons for animal food made from packing-house tankage, the quantity of tankage available for fertilizer would be about 210,000 tons.

To this quantity of tankage should be added whatever tankage is produced by rendering concerns located in the large cities. These renderers gather the meat scraps from local butcher shops and markets, and also utilize the dead animals of cities. The number of dead animals available for renderers has decreased somewhat in recent years, due to the displacement of the horse by the automobile and to the greater care exercised in transporting cattle and hogs, as a result of the high prices now received and more stringent State laws regarding the transportation of live stock. There are, however, no statistics available on which to base an estimate of the production from this source.

Terms of sale.—The greater part of the output of tankage and dried blood in the United States is sold through brokers who make a specialty of fertilizer materials. The usual brokerage commission on tankage and blood, which is always paid by the seller, is 25 cents per net ton. On sales to California consumers, however, a commission of 50 cents per net ton is generally charged because of the larger expense for telegrams, etc., which a broker who handles such business necessarily incurs.

Formerly packing house fertilizer materials were sold to the trade at a flat rate per ton, but to-day the price is generally based on the units of ammonia contained, as determined by chemical analysis, a unit being 1 per cent of a net ton, or 20 pounds. The ammonia content in such materials varies considerably, and, when the sales were made on the ton basis, the purchaser demanded a guarantee of a certain minimum amount of ammonia and bone phosphate of lime, as. for example, in the case of tankage, 9 per cent of ammonia and 20 per cent of bone phosphate of lime. In order to be on the safe side, therefore, the seller often found it necessary to exceed these figures and the purchaser received more of the two constituents than was guaranteed, while, if there was a shortage, the seller had to make it good. As this method of selling was not satisfactory, many of the packers decided to sell on the unit basis, the buyer to pay for what each lot analyzed. A low fixed price of 10 cents per unit was decided upon to govern the value of bone phosphate, while the unit price of the ammonia content was determined by market conditions. Thus $2.75 and 10 cents would mean that the ammonia was to be billed at $2.75 each unit or per cent (20 pounds) and the bone phosphate at 10 cents each unit or per cent in a ton. At this price tankage analyzing 9 per cent ammonia and 20 per cent bone phosphate would sell for 9×$2.75+20×$0.10, or $26.75 per ton.

On sales by the larger packers the weighing and sampling are always done at the point of shipment. The buyer usually has the privilege of having a representative present, or upon notice will be allowed board-of-trade weights at time of loading, the expense of which is borne by the buyer or sometimes jointly by buyer and seller when so agreed upon. The method of sampling is a matter of great importance. It is usually done by taking a small quantity from each cartload, if in bulk, or from each bag as loaded into the car. The sample is then thoroughly mixed and a certain quantity placed in containers and sealed, one for the seller's laboratory and another for the buyer. It is claimed that the variation in different analyses of the same lot is due more to the method of drawing the sample than of making the analysis.

The terms of settlement for the sale of tankage and dried blood vary somewhat. The Chicago packers, who are all equipped with laboratories, usually draw sight draft for the full amount of the invoice, with bill of lading and certificate of analysis attached. The practice of small eastern abattoirs, which are not usually equipped with laboratories, is to draw for three-fourths of the estimated value, the balance to be settled on receipt of chemist's analysis.

It is usual for the buyer to purchase on what is termed a "cost-and-freight" (c. a. f.) basis, which means that the freight to destination is added to the free-on-board (f. o. b.) price per unit of ammonia. Thus, if the Chicago f. o. b. price for high-grade ground tankage is $2.75 per unit of ammonia and 10 cents per unit of bone phosphate of lime, and the freight rate from Chicago to some market, say, Baltimore, is $4.40 per ton, which is equivalent to 40 cents per unit of ammonia for 11 per cent tankage, the c. a. f. price at Baltimore would be $3.15 and 10. In the days of railroad rebating this method of purchasing was of distinct advantage to the broker, who usually had an arrangement with the railroad by which a part of the freight paid was turned over to him. To-day the only advantage of buying on this basis is that the purchaser knows just what it costs him per unit laid down at his plant, and if a lower grade than that contracted for is shipped, the seller stands the difference in freight. Thus, on a shipment to Baltimore of 8 per cent tankage instead of 11, the difference in freight per unit of ammonia would be 15 cents.

Delivered prices are sometimes quoted instead of c. a. f. prices on shipments to points where public-weighing facilities are recognized by the trade as reliable. The main difference between the c. a. f. and delivered price is that the seller in the former case parts with title as soon as the car is loaded and the freight paid. He is at once entitled to payment for the material on the basis of his own weights and tests, and draws on the buyer immediately, receiving credit for the amount of the draft, whereas a "delivered" sale requires that the seller be responsible for the goods until actually laid down at the door of the purchaser.

Shipments of blood and tankage are often made in bulk in paper-lined cars, $1 per car being added to the invoice to cover cost of lining. If shipped in seller's bags, an additional charge to cover cost of bags is made; if in buyer's bags, no charge is made. Seller's bags are usually returnable at a certain price specified in the contract.

On sales of 50 tons or more by the large packers, the seller agrees to pay for an analysis by one of several chemists selected by the buyer and named in the contract; on sales of less than 50 tons the seller will furnish free an analysis made by his own laboratory, or the buyer may have one made at his own expense by one of a number of chemists named in the contract. This is the main difference between large and small sales.

Speculation in tankage.—The wide fluctuations in the price of tankage between the quiet and active seasons has invited considerable speculation in this material. Both the Armour Fertilizer Works and Swift & Co. contract for large quantities of tankage from smaller producers in the West and Middle West. These contracts often cover the output of a given plant for a period of six months to a year. The tankage is allowed to accumulate during the dull season and is resold to manufacturers during the active season. Morris & Co., Sulzberger & Sons Co., and The Cudahy Packing Co. do not make a practice of purchasing from other companies, but do allow their production to accumulate during the dull season. On future sales by the Chicago producers an advance of 5 cents per unit per month is usually demanded; thus on a contract made in July for January delivery 30 cents per unit of ammonia are added to the spot price. This increase of 5 cents per month is claimed to be for carrying charges, but as a matter of fact it is the minimum advance per month the packers expect to make in the price during the late summer and fall, for no such advance is demanded on sales made during January for delivery in March, and sales in March or April for June delivery are at a substantial decrease over the spot prices. This matter is more fully discussed in Chapter VI (see p. 150).

Brokerage concerns have in the past speculated to a considerable extent in tankage as well as other materials, but for the past few years the packers have kept this phase of the business largely to themselves.

Section 4. Proprietary tankages and base goods.

The increasing cost of nitrogen in the higher grade organic ammoniates used for fertilizer, which is due not only to the rapid growth of the mixed fertilizer industry but also to the increased use of some of these materials, especially cottonseed meal and tankage, for animal food, has resulted in the utilization of a variety of waste materials as a source of nitrogen. Among these, as mentioned before, are hair, fur, felt, feathers, wool waste, leather scraps and fleshings, garbage tankage, etc. The nitrogen contained in these materials, according to the conventional tests, is wholly unavailable or only slowly available, but by treating them according to various processes their availability is said to be considerably increased. Some of these processes are regarded as secret. In most cases, however, they consist either in treating the materials with sulphuric acid or in cooking them under pressure. In the case of leather scraps and fleshings the tannic acid, which is injurious to plants, is usually removed.

It has been claimed that if it were not for the utilization of such waste materials the price of ammoniates and nitrates would be very much higher than they are at present. W. H. Bowker, president of the Bowker Fertilizer Co., a subsidiary of The American Agricultural Chemical Co., in a letter to the Bureau of Corporations, November 17, 1914, makes the following statement on this point:

> When one realizes that every pound of by-product nitrogen is utilized in one form or another in this country and in Europe and that the industries which produce it are numerous and extensive, one can see that it runs into very large figures—figures which very materially influence the cost of nitrogen. The very fact that by-product nitrogen is utilized so extensively is what keeps down the price of imported nitrogen, especially in the form of nitrate of soda. * * *

Proprietary tankages.—There are a number of concerns in the United States making a specialty of so-called tankages, using a process which they claim to be more or less secret. These special tankages are usually sold on the basis of standard high-grade packing-house tankage, guaranteed to contain 10 to 11 per cent of ammonia. In some cases the basis of the tankage is packing-house tankage, to which is added some of the treated low-grade materials and also some sulphate of ammonia. One concern is said to make a "high-grade dried blood" from discarded printing-press rollers which are made from organic materials, and another reports having a contract with the Government Printing Office for its discarded printing-press rollers. The Central Leather Co., the largest concern in the United States engaged in tanning leather, produced in 1913 more than 1,500 tons of tankage from fleshings and waste from hides, which were sold to manufacturers of fertilizers.

Proprietary tankages are put on the market under various names. The Joslin-Schmidt Co., of Cincinnati, makes two brands, one known as "Georgia tankage," which is guaranteed to be free from tannic acid, and the other known as "Joslin-Schmidt's regular tankage." The Kanona Co. (Inc.), of Norfolk, Va., makes "Kanona" tankage. "Alpha tankage" is made at Wilmington, Del., and "Alba blood" at Aurora, Ill. The National Utilization Co., controlled by the F. S. Royster Guano Co., at Norfolk, owns the American rights to a German process for converting the slowly available nitrogen content of various waste products into available form. The "tankage" produced is used largely by the parent company.

Base goods.—A considerable number of fertilizer manufacturers make what is known in the fertilizer trade as "base goods" by treating certain low-grade organic nitrogenous materials with sulphuric acid. This is accomplished by mixing sulphuric acid and ground phosphate rock with crude materials such as hair, fur, felt, leather, garbage tankage, etc., in certain proportions, and placing the mass in a den or on a pile where a chemical action takes place which not only liberates the phosphoric acid content of the phosphate rock, but also renders the nitrogen content of the waste materials used more or less available. The laws of many States prohibit the sale of commercial fertilizers containing certain waste materials unless accompanied by an explicit statement to this effect. The manufacturers claim that the wet process of treating such materials so changes their physical and chemical nature that their availability is materially increased. There seems to be no question that part of the nitrogen particularly in animal wastes is rendered readily available. According to one authority the effect of sulphuric acid treatment on vegetable wastes such as peat and garbage tankage is slight.

The directors of the agricultural experiment stations of the New England States, New York, and New Jersey appointed a committee in 1910 to investigate the value of base goods as fertilizers. In 1911 this committee reported that in the factory of a prominent fertilizer company it witnessed the manufacture of some base goods, where hair tankage, garbage tankage, and treated leather, "unacidulated," were mixed with phosphate rock and sulphuric acid. C. H. Jones, chemist of the Vermont Agricultural Experiment Station, and member of this committee, submitted in this report the following tabulation to show the nature of the nitrogen that went into the base goods and the changes that occurred from the acid treatment:

	100 parts of the nitrogen contained—		
	Nitrogen in ammonia.	Water soluble organic nitrogen.	Water insoluble organic nitrogen.
	Per cent.	*Per cent.*	*Per cent.*
What went in	6.5	7.8	85.7
What came out	14.3	57.7	28

Commenting on the same matter in 1914, Mr. Jones said:

> This base mix has been tested by field, pot, and laboratory methods, and the results obtained have indicated, without exception, that the water soluble portion of its nitrogen—which equals about 72 per cent of the total—is as valuable agriculturally as dried blood, animal tankage, cottonseed meal, and other recognized high-grade ammoniates. This soluble organic nitrogen is evidently readily diffused through the soil and quickly changed by soil bacteria into forms utilized by growing crops. The remaining water insoluble nitrogen—about 28

per cent of the total—is not readily available. In the practical compounding of commercial fertilizers from a base mix this small amount of water insoluble nitrogen is fortified by the proper additions of blood, hoof meal, animal tankage, cottonseed meal, castor pomace, etc., so that we find, in a big majority of cases, in commercial fertilizer inspection work, that even the insoluble nitrogen will show an acceptable activity by laboratory methods and pot experiments.

Burt L. Hartwell and F. R. Pember, of the Rhode Island Experiment Station, who have made a study of this "wet process," stated in the Journal of Industrial and Engineering Chemistry, June, 1912, that "the experiments prove the efficiency of the wet process, when properly carried out, for materially increasing the availability of certain low-grade nitrogenous materials."

The United States Department of Agriculture, Bureau of Soils, in a bulletin entitled "Nitrogen of Processed Fertilizers," dated November 10, 1914, states:

> * * * It has been shown that by the process used in the case of this fertilizer the nonavailable nitrogenous materials have been made highly available, not only because the nitrogen compounds can be ammonified quickly in the soil, but also because these compounds are directly utilizable by plants. This change in the nature of the nitrogen compounds has been brought about by the partial hydrolysis of the proteins contained in the various trade wastes used in the manufacture of the fertilizer. * * *
>
> It may be stated that in general the more extended and final the hydrolysis the more available the nitrogen of the compounds formed, since, as has been shown, the final products of hydrolysis are utilized by the plant as such and are at the same time more readily changed into ammonia by bacteria, etc., than are the intermediate compounds produced by partial hydrolysis.

Section 5. Fish scrap.

Fish scrap is the residue obtained after extracting the oil from menhaden and other varieties of fish. It is also made from the waste products of fish-canning establishments. The nitrogen content of fish scrap varies considerably, according to the source from which it is obtained and the processes by which it is made. The dried fish scrap made from menhaden averages about 11 per cent of ammonia and 16 per cent bone phosphate of lime, while the acidulated scrap, on account of the much larger content of moisture, contains only about 6 per cent of ammonia and 3 per cent phosphoric acid.

The action of nitrogen in fish scrap is not as immediate as that in nitrate of soda or sulphate of ammonia, since the scrap is not soluble in water, and when mixed with the soil must ferment before the ammonia can be released. Nevertheless, fish scrap ranks among the best of the organic ammoniates used for fertilizing purposes and compares very favorably with dried blood.

Producers.—The menhaden industry of the Atlantic and Gulf coasts furnishes the principal source of domestic fish scrap in the United States. A small quantity is produced by fish canneries along the Atlantic coast. There are also about a dozen companies on the Pacific coast engaged in the production of fish scrap in connection with salmon canning or fish-oil extraction; in 1913 they produced about 3,000 tons.

A considerable quantity of foreign fish guano and whale guano is imported into the United States from Europe, especially when the menhaden catch on the Atlantic coast is small. The fish guano comes mainly from the herring and sardine industries.

Menhaden industry.—There are at present about 50 fish-scrap factories scattered along the Atlantic and Gulf coasts from Maine to Port Arthur, Tex., engaged in the extraction of fish oil from menhaden. The largest group of plants is located on Chesapeake Bay, in and around Reedville, Va. In 1912 this group comprised 20 factories, including one in Maryland, which together produced 40,255 tons of dried scrap. Nineteen of these plants produced in 1913, a poor year, 29,398 tons. Another important group of factories is located on the coast of North Carolina. This group contains 16 plants, 14 of which are located in or near Beaufort and Morehead City and two on the Cape Fear River near Wilmington, N. C. In 1912 this group produced only 5,465 tons of dried scrap, and in 1913 10 of the plants made 3,710 tons. The following is a list of the principal fish-scrap factories along the Atlantic and Gulf coasts in operation in 1914:

Maine: Deep Cove Manufacturing Co	Deep Cove, Me.
Connecticut:	
Niantic Menhaden Oil & Guano Co. (Inc.)	South Lyme, Conn.
Wilcox Fertilizer Co. (Inc.)	Mystic, Conn.
New York:	
Atlantic Phosphate & Oil Corporation, 165 Broadway, New York	Round Pond, Me. Promised Land, N. Y. Hicks Island, N. Y.
Products Manufacturing Co., 2 Rector Street, New York	Barren Island, N. Y.
Triton Oil & Fertilizer Co. (Inc.), 135 Front Street, New York	Amagansett, N. Y.
New Jersey:	
Atlantic Fisheries Co	Tuckerton, N. J.
Fifield Fish Oil & Fertilizer Co	Leesburg, N. J.
McKeever Bros. (Inc.)	Tuckerton, N. J.
Monmouth Oil & Guano Co. (Inc.)	Port Monmouth, N. J.
W. H. Sweezey	Do.
Delaware:	
Delaware Fish Oil Co. (Inc.)	Lewes, Del.
Lewes Fisheries Co. (Inc.)	Do.
Virginia:	
Bellows & Squires (Inc.)	Ocran, Va.
Coan River Guano Co	Lewisetta, Va.
Davis Packing Co. (Inc.), C. E	Reedville, Va.
Davis Palmer Co	Ditchley, Va.
Dennis Fish & Oil Co	Cape Charles, Va
The Douglas Co. (Inc.)	Reedville, Va.
The Edwards Co. (Inc.)	Do.
The Edwards & Reed Co	Do.
The Eubank-Tankard Co. (Inc.)	Kilmarnock, Va.
Indian Creek Fertilizer Co	Byrdton, Va.
Irvington Fish & Guano Co. (Inc.)	Irvington, Va.

Virginia—Continued.	
McNeal, Edwards Co. (Inc.)	Reedville, Va.
McNeal, Dodson Co	Do.
Menhaden Oil & Guano Co	Harborton, Va.
Morris Fisher Co. (Inc.)	Reedville, Va.
Norfolk Fisheries Co	Leasford, Va.
Reedville Oil & Guano Co	Reedville, Va.
Seaboard Oil & Guano Co	Mila, and Chincoteague Island, Va.
Virginia Fisheries (Inc.)	Ditchley, Va.
Taft Fish Co	Taft, Va.
Maryland:	
Dennis, L. E. P., & Son	Crisfield, Md.
Patuxent Fish & Oil Co. (Inc.)	Solomons, Md.
North Carolina:	
Beaufort Fish Scrap & Oil Co. (Inc.)	Beaufort, N. C.
Carolina Coast Products Co	Wilmington, N. C.
Carteret Fish & Oil Co	Morehead City, N. C.
Chadwick & Caffrey	Beaufort, N. C.
Davis, A. F	Davis, N. C.
Dey & Bro	Beaufort, N. C.
Doane & Bartlett	Do.
Ocean Fisheries Co. (sold March, 1914, to C. C. Chadbourn and associates)	Wilmington, N. C.
Stewart, K. B	Newport, N. C.
Charles S. Wallace	Morehead City, N. C.
Wallace Fisheries Co. (Inc.)	Do.
R. W. Taylor	Do.
T. G. Taylor & Bro	Newport, N. C.
A. T. Willis	Williston, N. C.
W. Irving Willis	Do.
Florida:	
Menhaden Products Co	Fernandina, Fla.
Southern Menhaden Co. (Inc.), Jacksonville, Fla	Fulton, Fla.
Texas:	
Gulf Menhaden Co	Houston, Tex.
Sabine Fish & Fertilizer Co	Sabine, Tex.

Process of production.[1]—In the menhaden industry the fish are caught in a purse seine carried around a school by small boats. After the seine has been hauled in, the fish are loaded into the hold of the steamer by means of a large dip net, operated by a block-and-tackle arrangement, and carried to the fish factory. There they are unloaded into storage bins by means of bucket elevators. From the storage bins they are conveyed automatically to the cooker, where they are treated with steam for about 20 minutes. The cooked fish are then fed by a mechanical conveyor into a power press, in which the water and oil are squeezed out. The residue material, or scrap is then placed in a hot-air dryer, where the moisture content is reduced to about 7 per cent. Before shipping to market the dried scrap is usually ground and bagged.

In a number of factories driers are not used, the scrap being exposed to the sun for three or four days on a platform and turned from time to time with rakes. In case conditions are not suitable for immediate drying on the platform, the material coming from the press is treated with sulphuric acid and sold as wet or acidulated scrap, or is held until weather conditions permit of drying. Resort is sometimes had to the acidulating process, even when the factory is equipped with machine driers, but can not immediately take care of the scrap.

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[1] For detailed discussion of the process of production, see Bulletin No. 2, Bureau of Soils, Department of Agriculture.

Statistics of production.—The Bureau of Fisheries took a census of the fish-scrap industry in 1912. Table 21 gives a summary of the results. Incomplete production figures for the year 1913 have also been obtained from the fish-scrap factories and other informants, which are given in Table 22. The decrease in the total output was due to the exceptionally poor catch of menhaden in that year. No statistics have been collected for the year 1914, which was an abnormal year owing not only to the poor catch but to the falling off in demand for the product following the outbreak of the European war.

TABLE 21.—STATISTICS OF THE MENHADEN INDUSTRY OF THE ATLANTIC COAST STATES IN 1912.

Item.	Connecticut and New York.[1]	New Jersey and Delaware.	Virginia.[2]	North Carolina and Florida.	Total.
Number of factories	8	7	20	13	48
Number of vessels:					
Steam	39	12	62	5	118
Gasoline		2	1	26	29
Total	39	14	63	31	147
Number of menhaden handled	317,405,700	148,517,400	511,061,050	84,859,600	[3]1,061,843,750
Pounds of other species handled	180,000		4,900,000	16,000	5,096,000
Manufactured products:					
Dry scrap, tons	2,242	2,923	40,255	5,465	50,885
Acidulated scrap, do	26,132	9,744		1,660	37,536
Crude or green scrap, do		99			99
Total	28,374	12,766	40,255	7,125	88,520
Oil, gallons	3,613,500	957,337	1,907,083	173,283	6,651,203
Value of manufactured products:					
Dry scrap	$68,255	$91,740	$1,208,321	$164,678	$1,532,994
Acidulated scrap	416,048	158,874		28,524	603,446
Crude or green scrap		1,725			1,725
Total	$484,303	$252,339	$1,208,321	$193,202	$2,138,165
Oil	838,216	247,831	426,948	38,995	1,551,990

[1] Includes one factory in Maine operated only a few weeks during 1912 and a floating factory now dismantled, both owned by a New York company.
[2] Includes one small factory in Maryland.
[3] 637,106,250 pounds.

TABLE 22.—STATISTICS OF THE MENHADEN INDUSTRY OF THE ATLANTIC COAST STATES IN 1913.

Item.	Connecticut and New York.	New Jersey and Delaware.	Virginia and Maryland.	North Carolina, Florida, and Texas.	Total.
Number of factories	7	7	22	18	54
Number of vessels	34	18	58	30	140
Manufactured products:					
Dry scrap, tons	1,812.00	810.76	[1]29,398.00	4,559.00	36,579.76
Acidulated scrap, do	6,023.00	5,704.00		2,039.00	13,766.00
Value of manufactured products:[2]					
Dry scrap	$58,147.08	$26,787.51	$931,034.66	$144,885.02	$1,160,854.27
Acidulated scrap	$101,306.86	$98,108.80		$36,865.12	$236,280.78

[1] Production of 19 factories.

[2] Estimated.

Use of fish scrap.—Practically all of the fish scrap produced along the Atlantic coast is used by fertilizer manufacturers as a source of ammonia in complete goods. Very little is sold to farmers for direct application to the soil. A small quantity of dried fish scrap is now being used for poultry food, especially along the coast of New Jersey and on Long Island.

A considerable portion of the total output of the Reedville (Va.) group of fish factories is sold directly to the Virginia-Carolina Chemical Co. The remainder is sold largely through three or four brokers making a specialty of this business to various fertilizer manufacturers having plants favorably located with respect to the Chesapeake Bay fish-scrap factories.

Most of the output of the North Carolina fish factories is consumed by fertilizer manufacturers in that State.

Terms of sale.—Fish scrap is now sold almost entirely on the basis of its ammonia content, as is tankage, the price being quoted at so much per unit of ammonia and 10 cents per unit of bone phosphate of lime in the case of dried scrap, and so much per unit of ammonia and 35 cents per unit of phosphoric acid in the case of acid scrap. The prices per unit of bone phosphate of lime and per unit of phosphoric acid are constant and do not vary from year to year. The analysis of the scrap is made by chemists in the principal fertilizer manufacturing centers, as the fish-scrap factories do not have laboratories of their own.

Fish scrap is handled by brokers both on their own account and on commission, the terms in the latter case being from 1 per cent to 1½ per cent of the net receipts, or sometimes merely 25 cents per ton. This commission is paid by the seller.

Contracts for the purchase of fish scrap are generally made with the factories in the winter and spring, before the fishing season opens. They sometimes embrace the entire season's output of a given factory, the deliveries being made as the scrap is produced. The price quoted by the factory is, as a rule, either f. o. b. fish-scrap factory or, in the case of the Chesapeake Bay factories, delivered to bay points, in the latter case the factories paying the schooner rate to Baltimore, Norfolk, or other points along the Bay where fertilizer factories are located or where railroad connections to interior points are made.

When brokers purchase the material outright from the factory they sell it according to the wishes of the consumer, whether f. o. b. factory or bay points, c. i. f. port, c. a. f. or "delivered" destination.

Speculation in fish scrap.—The uncertainty of the catch, sharp fluctuations in prices, and comparatively small quantity of scrap produced invite speculation in this material. Certain fertilizer brokers often purchase the season's output of a fish-scrap factory at a fixed price per unit of ammonia with the expectation of reselling at a profit.

One instance has come to the attention of the Commission where an individual entirely unacquainted with the fish-scrap industry took options on the entire season's output of a considerable number of factories with the expectation of being able to raise prices by controlling the supply. The attempt failed, however, because the large buyers kept out of the market, and at the outbreak of the European war the prices fell so sharply that the options had to be surrendered.

Concentration of fish-scrap factories.—All attempts to establish a combination of fish-scrap producers have thus far proved futile. The industry is to-day composed largely of independent producers. Prior to 1898 there was an organization of fish-scrap companies known as the United States Menhaden Oil & Guano Association, which embraced most of the factories along the coast of Connecticut, New York, and New Jersey. Little is known of its operations. The extent of the menhaden industry of the United States in each year from 1873 to 1898 is shown by returns of this association.[1]

In 1898 the American Fisheries Co. (Ltd.) was organized with a capital stock of $10,000,000, of which $8,000,000 was common and $2,000,000 preferred, for the purpose of acquiring various fish factories, steamers, and other property owned by the different menhaden interests along the North Atlantic Coast. Early in 1900 this company was placed in the hands of receivers, and shortly afterwards was reorganized under the name of the Fisheries Co., with a capital stock of $3,000,000, consisting of $1,000,000 common and $2,000,000 preferred, and a bond issue of $500,000. The new company secured control of nine plants, six of which were located at Port Arthur, Tex.; Lewes, Del.; Tiverton, R. I.; Promised Land, Long Island; one in North Carolina; and one on the Maine coast. The location of the other plants was not ascertained. The Fisheries Co. was incorporated May 25, 1900, under the laws of the State of New Jersey. On October 24, 1907, the company was placed in the hands of receivers.

The successor of the Fisheries Co. was known as the Menhaden Fishing Co., which was incorporated in 1908 under the laws of New Jersey with a capital stock of $50,000, later increased to $1,000,000, and bonded indebtedness of $200,000. This company owned plants at Lewes, Del., Tiverton, R. I., and Round Pond, Me.

The Atlantic Phosphate & Oil Corporation, 165 Broadway, New York, was incorporated February 6, 1913, with a capital stock of $6,000,000, consisting of $4,000,000 common and $2,000,000 preferred, and bonded indebtedness of $1,500,000. This company was a consolidation of the property of the Atlantic Fertilizer & Oil Co., with plants at Round Pond, Me., and Promised Land, L. I.; the Neptune Fishing Co., with plant at Hicks Island near Promised Land, L. I.;

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[1] See Bulletin No. 2, Bureau of Soils, Department of Agriculture, p. 7.

and the Menhaden Fishing Co., of Lewes, Del., which operated steamers only. The Atlantic Fertilizer & Oil Co. was purchased several years ago from Heller, Hirsh & Co., New York, N. Y., by interests connected with the International Agricultural Corporation. The Atlantic Phosphate & Oil Corporation also controlled the Volunteer State Phosphate Co. and the Hydraulic Phosphate Co., Tennessee corporations. During the year 1914 the Neptune Fishing Co. was sold to Swan & Finch Co., of New York, and the property of the Volunteer State Phosphate Co. to the International Agricultural Corporation. In 1914 the Atlantic Phosphate & Oil Corporation itself went into the hands of a receiver, and in 1915 its affairs were wound up.

The Chesapeake Bay fish-scrap factories are nominally independent, although in reality there is considerable interownership and community of interest. Four men have been pioneers in the establishment of these factories, and either they or their relatives or representatives are found on the directorate of almost every company. It is stated that all financial statements and yearly reports of the companies at Reedville are passed from one company to another so that every concern knows what the others are doing. In 1912 an effort was made to form a syndicate in Richmond to buy up the fish factories on the Chesapeake Bay. The movement, however, did not succeed.

There appears to be an association of owners of fish-scrap factories in the Chesapeake Bay region, which has for its object harmonious action in regard to wages of labor, State legislation, and other matters affecting their interests.

A movement was started in 1913 to combine all the factories located at Beaufort and Morehead City with a view to curtailing operating expenses by running only such factories as were necessary to handle the fish caught. It was also intended to mix and sell complete fertilizers. Two or three of the principal owners of fish factories in that locality were behind the project. These men appear also to be connected with a couple of small fertilizer concerns, one located at Newbern and the other at Washington, N. C. The project did not succeed.

Thus far it appears that the fertilizer manufacturers have made little effort to purchase fish-scrap factories in order to secure control of this source of ammonia.

CHAPTER IV.

PRODUCTION AND SALE OF PHOSPHATES.

Section 1. Introduction.

Phosphorus is one of the three essential elements of commercial fertilizers required by plants. It influences the prolificacy, as well as the time of maturity, of crops. The sources of phosphorus are various phosphates which will break up so as to release phosphoric acid when mixed with the soil. In the trade the compound phosphoric acid, rather than the element phosphorus, is the substance sought in the analysis of phosphates.

The principal phosphates used for fertilizer are acid phosphate, basic slag, and various bone products, such as steamed bone meal, raw bone meal, bone black, bone ash, etc. Raw ground rock phosphates are also used to a considerable extent. Of these various materials containing phosphoric acid, acid phosphate is by far the most important and forms the basis of most of the commercial fertilizers now made.

The phosphoric acid in acid phosphate and acidulated or dissolved bone is largely soluble in water, while that contained in basic slag and most bone products is not soluble in water and, for this reason, becomes available to plants more slowly. Bones also contain more or less nitrogen, depending upon the treatment to which they have been subjected.

Section 2. Basic slag.

Basic slag is a by-product obtained in the manufacture of steel from phosphatic pig iron by the basic Bessemer process. In order to remove the impurities in the pig iron, the molten metal is put into a converter with the addition of lime, and a cold air blast is injected through the molten mass, so that the impurities are burned or oxidized. The phosphorus in the iron is converted into phosphoric acid and unites with the lime to form calcium phosphate, which rises to the surface in the form of a scum and is separated from the molten steel by being poured off from the top of the converter. After this slag is cooled it is thoroughly pulverized and finely screened, and sold to the fertilizer trade under the name of basic cinder, basic slag meal, Thomas slag, or Thomas phosphate powder. The basic Bessemer process, which is applicable only to pig iron containing a high percentage of phosphorus, is not in use in the United States.

Some difference of opinion exists as to the chemical composition of basic slag, but most of the recent experiments tend to prove that it is a tetra-calcium or four-lime phosphate containing some iron and magnesium salts, and also some free lime. The phosphoric-acid content is not soluble in water, but will dissolve in a citrate or citric solution. On the basis of this test the basic slag imported contains from 15 to 19 per cent of available phosphoric acid. Basic slag is used principally as a direct fertilizer for apple and other fruit orchards. It is not suitable for use in complete fertilizers on account of the large quantity of lime contained.

Basic slag, which probably ranks second in importance as a source of phosphoric acid in the world's consumption, is produced in large quantities in Germany, France, Belgium, and England. The total output of these and other European countries is estimated at more than 4,000,000 metric tons annually. But very little is produced in the United States on account of the comparatively low phosphorous content of the non-Bessemer iron ores, so that practically our whole supply is imported. According to the figures published by the Bureau of Foreign and Domestic Commerce, 13,186 gross tons of basic slag were imported in 1913. It has been ascertained, however, through the cooperation of the above-mentioned bureau that large quantities of basic slag are being imported under the general heading "Materials used for fertilizer only." The American Agricultural Chemical Co. alone reported imports of 17,000 tons in 1913. In all probability the total imports exceed 25,000 tons. Table 23 shows the world's production of basic-slag phosphate by principal countries for the period 1907 to 1913, inclusive.

TABLE 23.—WORLD'S PRODUCTION OF BASIC-SLAG PHOSPHATE, 1907–1913.[1]

Country.	1907	1908	1909	1910	1911	1912	1913
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Germany	1,803,000	1,653,000	1,879,000	2,007,500	2,160,000	2,110,000	(2,250,000)
France	408,000	409,000	463,000	534,000	602,000	679,000	(700,000)
Belgium	325,000	249,000	335,000	488,000	471,000	534,000	655,000
United Kingdom	145,000	143,000	155,500	160,000	....	400,000	404,000
Luxemburg	....	....	....	....	....	253,000	(250,000)
Austria-Hungary	65,700	68,000	59,000	74,000	73,500	92,000	(100,000)
Sweden	....	9,020	6,936	12,345	....	14,978	16,821
Other countries	....	....	....	....	[2] (200,000)	[3] (61,000)	[4] (77,000)
Total	2,746,700	2,531,020	2,898.436	3,275,845	(3,506,500)	(4,143,978)	(4,452,821)

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[1] Compiled from publications of the Institute International d'Agriculture, Rome, Italy. Figures in parentheses represent the productive capacity of the factories; other figures are actual production.

[2] Including the United Kingdom.

[3] 25,000 tons of this amount is estimated, the remainder of 36,000 tons being the production of Italy and Russia.

[4] 25,000 tons of this amount is estimated, the remainder of 52,000 tons being the production of Italy and Russia.

Section 3. Bone products.

Bones have long been used as a source of phosphoric acid for fertilizing purposes, although to a less extent in recent years than formerly. The mineral matter in bones consists chiefly of tricalcium phosphate, while the organic matter contains considerable nitrogen. The calcium phosphate in raw bones amounts to nearly 50 per cent of the total.

The most common form in which bones are used for fertilizer is steamed bone meal. The bones are first boiled or steamed and the fats and most of the nitrogenous content extracted. They are then ground or thoroughly pulverized. Raw bone is less common in the fertilizer trade than steamed bone meal, for the reason that the fat and gelatine content of bones has no fertilizer value and is of great value for other purposes. The phosphoric acid content of raw bones is more slowly available than that of steamed bone meal, due to the fact that raw bone can not be as finely divided as the steamed bone, and its decomposition in the soil is further retarded by the fatty content which is removed by the steaming and degreasing process in steamed bone meal. Treating bones with sulphuric acid is now but little employed on account of the high price of bones and cost of the resulting product as compared with the lower cost of phosphoric acid in acid phosphate.

Formerly bone black, a waste material from sugar refining, was an important source of phosphorous. In making this material bones are cleaned and dried and then distilled in air-tight vessels, a bone charcoal being formed, which was formerly used in large quantities in clarifying sugar, but the modern process of sugar refining has largely done away with such use.

Bone ash is another source of phosphorous. It is obtained by burning bones, and is imported largely from South America.

Bone meal and other bone products used for fertilizer are prepared mostly by the large packers and fertilizer manufacturers. The bones are obtained from slaughtering or rendering establishments, or are imported. In 1913 bones valued at $636,876 were imported, a part of which was doubtless used in making bone meal. There were also imported 34,619 tons of bone ash and bone dust.

Section 4. Acid phosphate.

The terms "acid phosphate" and "superphosphate" are sometimes used indiscriminately. Superphosphate, however, is the broader term and applies to all acidulated phosphates, while acid phosphate is used to designate a product derived from ground rock phosphate by treating it with sulphuric acid. When the sulphuric acid is mixed with the ground rock in proper proportions, it unites with two parts of calcium of the tricalcium phosphate, forming gypsum, and leaves the phosphoric acid united with the remaining part of calcium in the form of monocalcic phosphate.[1] This compound is soluble in water and breaks up readily when mixed with the soil.

If an insufficient quantity of sulphuric acid is mixed with the phosphate rock, it unites with only one part of lime, leaving two parts united with the phosphoric acid in the form of dicalcic phosphate. If too much moisture is added to acid phosphate, the monocalcic phosphate will break up, forming less soluble compounds. Where this change has taken place the product is called reverted phosphate.

Commercial acid phosphate is a dark grayish salt. Practically all that produced contains some reverted phosphate, which, although not soluble in water, is soluble in a weak solution of ammonium citrate, now generally used by State fertilizer chemists as a test to determine the percentage of available phosphoric acid in acid phosphate.

There are various grades of acid phosphate manufactured, but the bulk of the output contains from 16 to 18 per cent of available phosphoric acid. Formerly when South Carolina phosphate rock was largely used, the principal grade of acid phosphate contained 14 per cent of available phosphoric acid. Some farmers still demand this grade in preference to the 16 per cent grade, believing that it is superior in quality.

Process of manufacture.—In the manufacture of acid phosphate as now conducted the broken phosphate rock coming from the mines is pulverized by steel rollers in a grinder or mill until from 70 to 90 per cent of it will pass through a fine screen, the particles which will not pass through being returned to the mill for further grinding. The fineness to which the rock is ground in the case of Florida rock is influenced by the cost of the two ingredients. Generally speaking, rock which costs more per ton at the plant than sulphuric acid is not ground as fine as when it costs less, for the finer the division of the rock the less the quantity of acid required. The ordinary mill will grind from 5 to 6 tons of Florida pebble rock in an hour and from 10 to 12 tons of Tennessee brown rock, which is not so hard as the Florida rock. After the grinding process the pulverized phosphate is conveyed into an acidulator or revolving pan equipped with paddles or stirrers, where it is mixed with about an equal portion of 50° Baumé sulphuric acid. These machines will mix from 1 to 2 tons of rock and acid in from two to five minutes. As soon as the mixture is complete the charge is dumped into a "den" or inclosed bin, where it is allowed to stand from 12 to 24 hours; or it is dumped upon an open pile, in which case a somewhat longer time is required to complete the chemical reaction. The heat generated by this reaction drives off a portion of the moisture, and the gypsum which is formed absorbs the balance in the mixture, so that at the end of a given period it is practically dry. In order to break up any lumps that may exist in the material, the acid phosphate, before being bagged for shipment, is usually run through a cage mill, which consists of two cylindrical cages, one within the other, revolving in opposite directions.

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[1] The chemical reaction in making acid phosphate is as follows: $Ca_3(PO_4)_2 + 2H_2SO_4 = CaH_4(PO_4)_2 + 2CaSO_4$.

The "den" system is used mostly at plants in the Northern States located in or near large towns and cities. The open dump system predominates in the territory south of Norfolk and Richmond. The den system necessitates handling an additional time with its consequent expense. There is no difference in the resulting product.

The theoretical amount of 50° acid required to combine with the tricalcium phosphate in 68 per cent phosphate rock, the grade of Florida rock most used for domestic consumption, is 1,382 pounds of acid to a net ton of rock; but, since there are other substances present in the rock in addition to the calcium phosphate (silica; carbonates of lime and magnesia; compounds of iron and alumina, the most objectionable of the impurities found; and calcium fluoride) which neutralize some of the acid, about a ton of 50° acid is required in order to liberate all of the phosphoric acid in a ton of rock. In actual practice, however, slightly less than the required quantity of acid is used, since a better mechanical condition is obtained thereby.

Principal producers.—Acid phosphate is produced mainly by the large fertilizer manufacturers, whose plants are equipped with machinery for grinding the rock and often with acid chambers for producing the sulphuric acid. Those not equipped with acid chambers purchase their sulphuric acid from outside sources. There are only a few concerns engaged in manufacturing and selling acid phosphate which are not also manufacturers of mixed fertilizers. Most important of these perhaps is the Phosphate Mining Co., which has a large plant at Savannah. This company is controlled by Peters, White & Co., fertilizer brokers with headquarters in New York City.

There are at present about 256 plants in the United States manufacturing acid phosphate. A little more than half of these have their own lead chambers for manufacturing sulphuric acid, while the remainder purchase their acid. The Virginia-Carolina Chemical Co. has 41 plants for manufacturing acid phosphate; The American Agricultural Chemical Co., 24 plants; International Agricultural Corporation, 19 plants; Armour Fertilizer Works, 14 plants; Swift & Co., 8 plants; F. S. Royster Guano Co., 5 plants; and Baugh & Sons Co., 2 plants.

The quantity of acid phosphate produced in 1913 by the seven largest manufacturers, including subsidiaries, was about 1,823,000 tons, or nearly 46 per cent of the total production of 4,000,000 tons estimated below. The three largest companies (Virginia-Carolina Chemical Co., The American Agricultural Chemical Co., and International Agricultural Corporation) produced 1,263,000 tons, or nearly 32 per cent of the total, and the four next largest (Armour Fertilizer Works, Baugh & Sons Co., F. S. Royster Guano Co., and Swift & Co.) produced nearly 560,000 tons, or 14 per cent of the total estimated production.

Figures showing the total production of acid phosphate in the United States are not available for 1913. The total domestic consumption of phosphate rock, however, is known (see p. 96) and on this basis a rough estimate of the total production of acid phosphate can be made. The latest official figures on the output of acid phosphate are those published by the Census for 1909, which show a total production of 3,040,219 tons. The domestic consumption of phosphate rock in 1909 was 1,329,611 long tons. This gives a ratio of about 2.3 tons of acid phosphate produced for 1 ton of rock used. On the basis of this ratio of 2.3 to 1, the 1,744,713 long tons of rock used in 1913 would make more than 4,000,000 tons of 16 per cent acid phosphate, an increase of 32 per cent over 1909.

Cost of production.—The principal items of cost in the manufacture of acid phosphate are rock, including the freight on it from the mines to the plant, and sulphuric acid. The Commission has secured cost data for the year 1913 for 19 large plants operated by the seven largest fertilizer manufacturers. These plants are located as follows: Carteret, 1 plant; Philadelphia, 1 plant; Baltimore, 4 plants; Wilmington, 2 plants; Charleston, 1 plant; Savannah, 3 plants; Atlanta, 3 plants; Macon, Americus, Augusta, and Nashville, 1 plant each. The total output of the 19 plants in 1913 was 661,800 tons. Table 24 below shows the average cost per ton at these plants grouped according to geographical location and itemized so as to show the cost of rock and sulphuric acid, operating labor, and other works expense, including depreciation, repairs and renewals, and general expense. Interest on the investment is not included.

TABLE 24.—AVERAGE COST PER NET TON OF PRODUCING ACID PHOSPHATE AT 19 PLANTS, GROUPED ACCORDING TO GEOGRAPHICAL LOCATION, FISCAL YEAR 1913.

Item.	North Atlantic ports.[1]	South Atlantic ports.[1]	Southern interior points.[2]	All points combined.	Percentage of total cost.
Tons produced	263,448	177,572	220,780	661,800	....
Materials:					
Cost of rock, including freight	$2.67	$2.56	$2.90	$2.72	40.8
Cost of sulphuric acid	2.48	2.58	3.07	2.70	40.5
Total cost of materials	5.15	5.14	5.97	5.42	81.3
Operating labor	.32	.41	.25	.32	4.8
Other works expense[3]	.91	.80	.53	.75	11.3
General expense	.16	.25	.12	.17	2.6
Total cost above materials	1.39	1.46	.90	1.24	18.7
Total manufacturing cost[4]	6.54	6.60	6.87	6.66	100.0

[1] Includes 6 plants.
[2] Includes 7 plants.
[3] Includes depreciation, repairs, and renewals.
[4] Does not include interest on investment or any form of selling expense.

As shown by the above table, the average cost of manufacturing acid phosphate ranged from $6.54 per ton at North Atlantic ports to $6.60 at South Atlantic ports and $6.87 at southern interior points, with an average for the 19 plants of $6.66 per ton. The cost of rock, including freight, and the cost of sulphuric acid, which includes the cost of pyrites, labor, depreciation, etc., where manufactured at the plant, and freight where purchased from other manufacturers, together averaged $5.42 per ton for the 19 plants combined, or 81.3 per cent of the total cost of $6.66. The average cost of sulphuric acid at all plants combined was only 2 cents per ton less than the cost of rock, but at southern interior points it cost 17 cents per ton more than the rock, while at North Atlantic ports the acid cost was 19 cents per ton less than the cost of the rock. The item of cost above materials constituted 18.7 per cent of the combined manufacing cost of $6.66 per ton, of which operating labor constituted 4.8 per cent, other works expense (depreciation, repairs, and renewals) 11.3 per cent, and general expense 2.6 per cent. This item at southern interior points was only 90 cents per ton as compared with $1.46 at South Atlantic ports and $1.39 at North Atlantic ports.

A comparison of the average costs at Baltimore (3 plants), Savannah (3 plants), Atlanta (3 plants), and Americus, Augusta, and Macon combined, is shown in Table 25 below:

TABLE 25.—AVERAGE COST PER NET TON OF PRODUCING ACID PHOSPHATE AT BALTIMORE, SAVANNAH, ATLANTA, AND AT AMERICUS, AUGUSTA, AND MACON COMBINED, FISCAL YEAR 1913.

Item.	Baltimore, Md.	Savannah, Ga.	Atlanta, Ga.	Americus, Augusta, and Macon.
Tons produced	146,025	93,803	89,171	92,994
Materials:				
Cost of rock, including freight	$2.71	$2.56	$3.13	$2.87
Cost of sulphuric acid	2.37	2.66	2.94	3.27
Total cost of materials	5.08	5.22	6.07	6.14
Operating labor	.28	.30	.27	.23
Other works expense	.75	.87	.65	.53
General expense	.17	.27	.13	.08
Total cost above materials	1.20	1.44	1.05	.84
Total manufacturing cost	6.28	6.66	7.12	6.98

The average cost of manufacturing acid phosphate for the three Baltimore plants, as shown by the table, is 38 cents less than the average cost at Savannah, 84 cents less than at Atlanta, and 70 cents less than at the three interior Georgia points combined. It is also 26 cents less than the average cost for the six plants located at North Atlantic ports shown in Table 24. Figures obtained from other plants at Baltimore show a somewhat higher manufacturing cost than that of the three plants whose figures were used in computing this table. Baltimore's greatest advantage lies apparently in the cost of sulphuric acid, which was 29 cents less than at Savannah, 57 cents less than at Atlanta, and 90 cents less than the average cost for the three plants at Americus, Augusta, and Macon combined. On the other hand, rock, including freight, cost 15 cents per ton more than at Savannah, which is nearer the mines. Atlanta and the three other Georgia interior points show a higher manufacturing cost than the two coast points, due mainly to higher transportation charges for the rock and the acid or materials used in making the acid. The cost above materials was $1.44 per ton at Savannah, $1.20 at Baltimore, $1.05 at Atlanta, and $0.84 at Americus, Augusta, and Macon combined. These cost figures do not include interest on investment or selling expense. The average wholesale price of 16 per cent bulk acid phosphate at Baltimore in February, 1913, was only 18 cents per ton above the actual average cost shown in the table (see p. 152), while at Savannah the average price during the months of February, March, April, July, and August, 1913, and January to April, 1914, was below the cost of production in 1913.

Since the outbreak of the European war the cost of producing acid phosphate has increased. The manufacturers state that scarcity of vessels and high freight rates have increased the cost of Spanish pyrites, from which most of the sulphuric acid is made. The demand for sulphuric acid in the manufacture of explosives has also raised the cost to fertilizer manufacturers.

Sale of acid phosphate.—The large manufacturers of acid phosphate consume a considerable proportion of their output in the manufacture of mixed fertilizers and sell their surplus either directly or through middlemen to dry mixers and consumers. The usual commission paid to brokers is 10 cents per ton. Acid phosphate is sold both in bulk and in bags. In the latter case it is required to be registered in most States under a brand name and tagged and guaranteed to contain a certain per cent of phosphoric acid.

Table 26 shows the quantities of acid phosphate consumed in mixed goods and sold in bulk and in bags in the fiscal year 1913 by seven of the large producers:

TABLE 26.—TONS OF ACID PHOSPHATE CONSUMED IN MIXED GOODS AND TONS SOLD IN BAGS AND IN BULK BY SEVEN LARGE FERTILIZER MANUFACTURERS DURING THE SEASON OF 1913.

Company.	Tons consumed.	Tons sold in bags.	Tons sold in bulk.	Total tons consumed and sold.
Virginia-Carolina Chemical Co.[1]	319,882	133,864	131,695	585,441
The American Agricultural Chemical Co	359,381	69,212	71,624	500,217
Armour Fertilizer Works[2]	260,032	48,082	42,993	351,107
International Agricultural Corporation[3]	68,087	11,553	176,541	256,181
F. S. Royster Guano Co	107,091	20,636	27,483	155,210
Swift & Co	107,688	24,272	25,849	157,809
Baugh & Sons Co.[4]	43,545	14,684	56,021	114,250
Total	1,265,706	322,303	532,206	2,120,215

[1] Includes Southern Cotton Oil Co. and most of affiliated companies.

[2] Does not include Los Angeles factory.

[3] Includes 100 per cent companies, but no affiliated companies.

[4] Includes Baugh & Sons Co., of Philadelphia; Baugh Chemical Co. of Baltimore County; and Baugh & Sons Co. of Baltimore City.

The total quantity consumed and sold in 1913 by the seven large companies amounted to 2,120,215 tons. The quantity consumed in the manufacture of mixed goods was 1,265,706 tons, or 59.7 per cent of the total, that sold in bags, being 322,303 tons, or 15.2 per cent, while that sold in bulk was 532,206 tons, or 25.1 per cent of the total handled. The bagged acid phosphate went to consumers, while the bulk material was used mainly by other manufacturers and manipulators. Taking the acid phosphate consumed and sold in bags by the seven companies as a basis for the distribution of the estimated production of 4,000,000 tons (see p. 91), 3,200,000 tons, or 80 per cent, were used in mixed goods, and 800,000 tons, or 20 per cent, were sold to consumers in unmixed form.

Section 5. Phosphate rock.

Phosphate rock now furnishes the principal source of phosphorus in fertilizers, not only in the United States, but also in European countries. At the present time most of the phosphate rock mined in the United States comes from Florida and Tennessee. Formerly a large part of the total output was mined in South Carolina, but since the discovery of higher-grade deposits in other States mining operations in South Carolina have gradually dropped off, so that only a little over 100,000 tons were mined there in 1914, as compared with 270,000 tons in 1904. In a number of Western States, especially Idaho, Utah, and Wyoming, extensive deposits of high-grade phosphate rock have been discovered, which, as yet, have scarcely been touched, and in a number of Southern States there are also extensive low-grade deposits which have not yet been worked.

The United States not only mines all the phosphate rock used for domestic consumption, but also exports considerable quantities to Europe in competition with the mines in France and Belgium, as well as with those in northern Africa and the South Sea Islands. The exports of phosphate rock to Europe from the United States are made almost entirely from Florida.

The total production of phosphate rock in Florida, South Carolina, Tennessee, and other States is shown by Table 27. In 1913 the total output was considerably more than 3,000,000 long tons, which was the largest in the history of the industry. Florida marketed 81.8 per cent, Tennessee 14.5 per cent, South Carolina 3.5 per cent, and Idaho and Wyoming 0.2 per cent of the total. No phosphate rock has been imported since 1909, except possibly a small amount of apatite from Canada. Of the total production, 1,366,508 long tons were exported, leaving 1,744,713 tons for domestic consumption.

TABLE 27.—ANNUAL MARKETED PRODUCTION OF PHOSPHATE ROCK BY STATES, TOGETHER WITH IMPORTS, EXPORTS, AND DOMESTIC CONSUMPTION, 1904–1914.[1]

Item.	1904	1905	1906	1907	1908	1909
Florida:	*Gross tons.*	*Gross tons.*	*Gross tons.*	*Gross tons.*	*Gross tons.*	*Gross tons.*
Hard rock	531,087	577,672	587,598	646,156	595,743	513,585
Land pebble	460,834	528,587	675,444	675,024	1,085,199	1,266,117
River pebble	81,030	87,847	41,463	36,185	11,160	....
Total	1,072,951	1,194,106	1,304,505	1,357,365	1,692,102	1,779,702
South Carolina:						
Land rock	258,806	234,676	190,180	228,354	192,263	201,254
River rock	12,000	35,549	33,495	28,867	33,232	6,700
Total	270,806	270,225	223,675	257,221	225,495	207,954
Tennessee:						
Brown rock	530,571	438,139	510,705	594,594	374,114	274,410
Blue rock		44,031	35,669	38,993	79,717	66,705
White rock		689	1,303	5,025	1,600	....
Total	530,571	482,859	547,677	638,612	455,431	341,115
Western States	....	....	....	....	....	[5] 9,493
Other States	100	....	[2] 5,100	[3] 12,145	[3] 13,110	....
Grand total	1,874,428	1,947,190	2,080,957	2,265,343	2,386,138	2,338,264
Imports	130,214	56,421	23,281	25,876	26,734	11,903
Total	2,004,642	2,003,611	2,104,238	2,291,219	2,412,872	2,350,167
Domestic exports	842,484	934,940	904,214	1,018,212	1,196,175	1,020,556
Domestic consumption	1,162,158	1,068,671	1,200,024	1,273,007	1,216,697	1,329,611

[1] Compiled from Annual Reports of U. S. Geological Survey.
[2] Includes Arkansas and Idaho.
[3] Includes Arkansas, Idaho, Utah, and Wyoming.

TABLE 27.—ANNUAL MARKETED PRODUCTION OF PHOSPHATE ROCK BY STATES, TOGETHER WITH IMPORTS, EXPORTS, AND DOMESTIC CONSUMPTION, 1904–1914—Continued.

	1910	1911	1912	1913	1914
Florida:	*Gross tons.*	*Gross tons.*	*Gross tons.*	*Gross tons.*	*Gross tons.*
Hard rock	438,347	443,511	493,481	489,794	309,689
Land pebble	1,629,160	1,992,737	1,913,418	2,055,482	1,829,202
River pebble	....	(1)	(1)	(1)	(1)
Total	2,067,507	2,436,248	2,406,899	2,545,276	2,138,891
South Carolina:					
Land rock	179,659	169,156	131,490	109,333	106,919
River rock		....	....	....	....
Total	179,659	169,156	131,490	109,333	106,919
Tennessee:					
Brown rock	329,382	[2] 365,068	359,692	451,559	483,203
Blue rock	[3] 68,806	[3] 72,302	[3] 63,639		
White rock	....	....	....	....	....
Total	398,188	437,370	423,331	451,559	483,203
Western States	[4] 9,634	[4] 10,505	[4] 11,612	[5] 5,053	[5] 5,030
Other States	....	....	....	....	....
Grand total	2,654,988	3,053,279	2,973,332	3,111,221	2,734,043
Imports	....	....	....	....	....
Total	2,654,988	3,053,279	2,973,332	3,111,221	2,734.043
Domestic exports	1,083,037	1,246,577	1,206,520	1,366,508	964,114
Domestic consumption	1,571,951	1,806,702	1,766,812	1,744,713	1,769,929

[1] Included in land pebble.
[2] Includes small quantity from Kentucky.
[3] Includes small quantity from Arkansas.
[4] Includes Idaho, Utah, and Wyoming.
[5] Includes Idaho and Wyoming.

The present world production of phosphate rock is estimated at more than six and one-half million metric tons. On the basis of the 1912 figures the United States produces about 45 per cent, France and Belgium together about 8 per cent, Algeria and Tunis together about 36 per cent, and the Christmas, Ocean, and Nauru Islands 7 per cent. Table 28 shows the world's production of phosphate rock in metric tons, by countries, for period 1907–1913.

TABLE 28.—WORLD'S PRODUCTION OF PHOSPHATE ROCK AND APATITE, BY COUNTRIES, 1907–1913.[1]

Country.	1907	1908	1909	1910	1911	1912	1913
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Phosphate rock:							
United States[2]	2,301,702	2,424,436	2,367,551	2,697,601	3,102,284	3,021,054	3,161,156
Tunis	1,069,000	1,300,500	1,223,512	1,286,262	1,446,633	2,057,498	2,284,678
Algeria	315,000	452,060	351,491	319,069	332,897	377,601	438,601
France	375,000	485,607	397,908	333,506	380,000	330,000	335,000
Belgium	181,230	198,030	205,260	202,880	240,000	203,100	[3] (200,000)
Christmas Islands	290,000	109,097	105,481	137,700	153,000	159,512	152,405
Ocean and Nauru Islands	190,000	301,160	197,922	310,625	303,000	300,000	....
Other countries	58,185	54,408	26,481	28,749	25,486	240,333	[4] 312,360
Total	4,780,117	5,325,298	4,875,606	5,316,392	5,983,300	6,689,098	6,884,200
Apatite	7,827	3,393	998	1,341	506	164	....
Grand total	4,787,944	5,328,691	4,876,604	5,317,733	5,983,806	6,689,262	6,884,200

[1] Figures for United States taken from Mineral Resources of the United States, other figures taken from "Production et Consommation des Engrais Chemiques dans le Monde," Rome, 1914.
[2] Figures for United States are for the marketed production.
[3] Estimated.
[4] Of this amount, 8,000 tons are the estimated production of Japan.

Raw rock phosphate.—Finely ground raw phosphate rock, sometimes called "floats," is used to a considerable extent by farmers, particularly in the Middle West, as a source of phosphorus. It is often lower in phosphate of lime content and consequently higher in iron and alumina than rock used for acidulating purposes. This material is applied directly in turning under crops or is mixed with barnyard manure, the theory being that the phosphorus in raw rock is rendered available by the action of the acids formed in the decomposition of organic matter, such as green and ordinary farm manures.

Florida phosphate rock.—The phosphate deposits of Florida are located in a tier of counties parallel to the west coast. These deposits are of two kinds—hard rock and pebble rock. The hard-rock deposits extend through a distance of about 100 miles north and south. The principal mines are located in Marion and adjoining counties. The land pebble deposits are located to the south of the hard-rock deposits, the principal mines being in Polk and Hillsboro Counties. The mining of river pebble deposits in Peace River, which formerly was an important source of phosphate rock, has practically ceased.

In 1913 there were some 30 companies engaged in the mining of phosphate rock in Florida. Of these 14 were mining hard rock and 16 land pebble rock. Several mining companies are owned or controlled by large fertilizer manufacturers or their subsidiaries, and several are owned by foreign companies which export most of their output. The following list gives the names, location, and ownership of all the mining companies operating in Florida in 1913:

I. LAND PEBBLE PHOSPHATE ROCK.

The American Agricultural Chemical Co., 2 Rector Street, New York (F. M.).[1]
    Pierce Phosphate Co., New York, N. Y., and Pierce, Fla.
    Palmetto Phosphate Co., Baltimore, Md., and Tiger Bay, Fla.
Armour Fertilizer Works, Chicago, Ill., and Bartow, Fla. (F. M.).
Compagnie Générale des Phosphates de la Floride, Paris, France, and Pembroke, Fla. (For.).[2]
Coronet Phosphate Co., New York, N. Y., and Lakeland, Fla.
The Dominion Phosphate Co., Bartow, Fla.
International Agricultural Corporation, 165 Broadway, New York, N. Y. (F. M.).
    Florida Mining Co., New York, N. Y., and Mulberry, Fla.
    Prairie Pebble Phosphate Co., New York, N. Y., and Mulberry, Fla.
International Phosphate Co., Boston, Mass., and Fort Meade, Fla.
Interstate Chemical Corporation, Charleston, S. C., and Bowling Green, Fla. (F. M.).
Peters, White & Co., 55 John Street, New York (F. B.).[3]
    The Phosphate Mining Co., New York, N. Y., and Nichols, Fla.

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[1] F. M.=Fertilizer manufacturers.
[2] For.=Foreign company.
[3] F. B.=Fertilizer brokers.

F. S. Royster Guano Co., Norfolk, Va. (F. M.).
  Florida Phosphate Mining Co., Norfolk, Va, and Bartow, Fla.
Société Franco-Américaine des Phosphates de Medulla (successor to Standard Phosphate Co.), Christiana, Fla. (For.).
Swift & Co., Chicago, Ill. (F. M.).
  State Phosphate Co., Bartow, Fla.
Virginia-Carolina Chemical Co., Richmond, Va. (F. M.).
  Charleston (S. C.) Mining & Manufacturing Co., Charleston, S. C., and Fort Meade, Fla.
  Amalgamated Phosphate Co.,[1] Baltimore, Md., and Chicora, Fla.

II. HARD ROCK.

P. Bassett (successor to Central Phosphate Co.), Newberry, Fla.
Peter B. & Robert S. Bradley,[2] Boston, Mass., and Floral City, Fla.
J. Buttgenbach & Co., Holder, Fla. (For.).
Camp Phosphate Co. (C. & J. Camp), Ocala and Dunnellon, Fla.
Cummer Lumber Co., Jacksonville and Newberry, Fla.
The Dunnellon Phosphate Co., Rockwell, Fla.
Dutton Phosphate Co., Gainesville, Fla.
Franklin Phosphate Co., Newberry, Fla.
Holder Phosphate Co., Cincinnati, Ohio; Ocala and Inverness, Fla.
Istachatta Phosphate Co., Istachatta, Fla.
Mutual Mining Co.,[3] Savannah, Ga., and Newberry, Fla.
Schilman & Bene, Ocala, Fla. (For.).
The Southern Phosphate Development Co., Ocala and Inverness, Fla.
T. A. Thompson, Neals, Fla.

In addition to the above list of companies, three new companies, viz: The Acme Phosphate Co., Chicago, Ill., and Morriston, Fla.; The Export Phosphate Co., Boston, Mass., and Mulberry, Fla.; The Lakeland Phosphate Co., Lakeland, Fla., are reported to have been organized.

The large fertilizer manufacturers own extensive areas of phosphate lands in Florida and, as indicated by the above table, are the principal miners of land pebble rock, the hard rock mined being largely exported. The proportion of the total acreage of phosphate lands and of minable phosphate rock held by these large companies can not be stated, because the total acreage of phosphate lands in Florida and the total tons of minable rock in the ground are not definitely known. Table 29 shows the land holdings, the estimated tonnage owned by the three largest fertilizer manufacturers, and also the number of tons mined by each in 1913.

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[1] In 1915 this company was acquired by the Ammo-Phos Corporation, which is owned by the Virginia-Carolina Chemical Co. and James B. Duke interests.

[2] Owned by interests connected with The American Agricultural Chemical Co.

[3] Connected with the Mutual Phosphate Co., of Savannah, fertilizer manufacturers.

TABLE 29.—HOLDINGS OF PHOSPHATE LANDS IN FLORIDA, ESTIMATED TONNAGE IN GROUND, AND TONS MINED BY COMPANIES IN 1913.

Company.	Prospected land.	Unprospected land.	Estimated tonnage.	Tons mined in 1913.
	Acres.	*Acres.*	*Gross tons*	*Gross tons.*
The American Agricultural Chemical Co.[1]	7,314	19,633	75,000,000	320,675
Palmetto Phosphate Co	23,000	....		
Virginia-Carolina Chemical Co.[2]	9,620	[3] 5,740	25,000,000	167,165
International Agricultural Corporation	15,300	[4] 19,280	37,712,895	673,277

[1] In addition, this company owns through its subsidiary the American Phosphate Mining Co. more than 55,000 acres of land, which may contain some phosphate.

[2] In addition, the Virginia-Carolina Chemical Co. had in 1913 a 50 per cent interest in the Amalgamated Phosphate Co., owning extensive pebble phosphate properties and plant in Florida.

[3] Surface rights only.

[4] In addition the company, according to its annual report for 1913, owns about 7,700 acres not accounted for in the above table.

The three companies shown in the above table together mined 1,161,117 gross tons of Florida phosphate rock in 1913 out of a total of 2,545,276 gross tons, or about 46 per cent. This rock was entirely land pebble and constituted about 56 per cent of the total land pebble rock mined. The Armour Fertilizer Works owns a deposit of pebble rock and operates a plant, the production of which meets about one-third of the requirements of the company. Swift & Co. own more than 2,300 acres, estimated to contain at least 1,600,000 tons of rock, and operate a plant which produced approximately 70,000 tons in 1913.

Tennessee phosphate rock.—Three kinds of phosphate rock are found in Tennessee. They are classed according to color into brown rock, blue rock, and white rock. The brown-rock deposits are located in Maury, Hickman, and Giles Counties and supply the greater part of the total output. The blue-rock deposits are located mainly in Maury, Lewis, Hickman, Perry, and Wayne Counties. The white-rock deposits are located mainly in Perry and Decatur Counties, but they have not been mined since 1908. The quantity and value of phosphate rock marketed in Tennessee has steadily increased from 341,115 gross tons, valued at $1,310,529, in 1909, to 483,203 gross tons, valued at $1,822,770, in 1914, or an increase of more than 39 per cent in value.

Several of the large fertilizer manufacturers have acquired extensive holdings of phosphate lands in Tennessee and are the principal miners of rock. There is only one foreign company now operating mines in this State. The following list gives the names and locations of all the mines in operation in Tennessee in 1913. Ownership by fertilizer manufacturers is indicated.

The American Agricultural Chemical Co., 2 Rector Street, New York, N. Y. (F. M.[1])
    American Phosphate Mining Co., Wales, Tenn.
Blue Grass Phosphate Co., Mount Pleasant, Tenn.

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[1] F. M.—Fertilizer manufacturer.

Central Phosphate Co., Mount Pleasant, Tenn. (For.[1])
Corn Belt Phosphate Co., Harvey, Ill., Centerville, Tenn.
Farmers' Ground Rock Phosphate Co., Mount Pleasant, Tenn.
Federal Chemical Co., Louisville, Ky., and Columbia, Tenn. (F. M.)
International Agricultural Corporation, New York, N. Y., and Mount Pleasant, Tenn. (F. M.)
Independent Phosphate Co., Columbia, Tenn.
Morgan Mining Co., Columbia, Tenn.
Natural Phosphate Co., Nashville, Tenn.
Petrified Bone Mining Co., Mount Pleasant, Tenn.
Preston Mining Co., Columbia, Tenn.
Ruhm Phosphate Mining Co., Mount Pleasant, Tenn.
Standard Phosphate & Chemical Co. (Hoover & Mason), Chicago, Ill.
Virginia-Carolina Chemical Co., Richmond, Va. (F. M.)
Charleston (S. C.) Mining and Manufacturing Co., Charleston, S. C., and Mount Pleasant, Tenn.

In addition to the fertilizer manufacturers shown in the above list as mining rock in 1913, two other companies—Armour Fertilizer Works and Swift & Co.—have some phosphate-rock lands in Tennessee. The holdings of these fertilizer manufacturers have not been prospected as completely as have their holdings in Florida. Table 30 shows the acreage held, estimated tonnage in the ground when known, and the tons mined in 1913 as reported to the Commission by the three largest fertilizer companies.

TABLE 30.—HOLDINGS OF PHOSPHATE LANDS IN TENNESSEE, ESTIMATED TONNAGE IN GROUND, AND TONS MINED BY COMPANIES IN 1913.

Company.	Prospected land.	Unprospected land.	Estimated tonnage.	Tons mined in 1913
	Acres.	*Acres.*	*Gross tons.*	*Gross tons.*
The American Agricultural Chemical Co.		2,000		11,412
Virginia-Carolina Chemical Co.	12,811		12,000,000	147,589
International Agricultural Corporation[1]	7,427		21,000,000	88,233

[1] Includes property of the Volunteer State Phosphate Co. acquired in December, 1913.

These three fertilizer companies in 1913 mined 247,000 gross tons out of a total of 451,559 tons, or about 55 per cent. Only 11 other companies were in operation in that year, the most important of which were the Federal Chemical Co., Louisville, Ky., and the Standard Phosphate mine, owned by Hoover & Mason, of Chicago.

Of the total tons of phosphate rock mined in the United States in 1913, amounting to 3,111,221 long tons, 1,500,919 tons or more than 48 per cent were mined by the The American Agricultural Chemical Co., Virginia-Carolina Chemical Co., and the International Agricultural Corporation.

Process of mining.—The process of mining phosphate rock varies somewhat according to the character of the deposits. In general the operation consists of (1) removing the overburden, (2) digging the rock, (3) washing and crushing, and (4) drying. Practically all of the Florida rock and the Tennessee brown rock are mined in open pits, while the Tennessee blue rock is mined by shafts as is coal.

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[1] For.=Foreign.

In mining by the open-pit method the overburden is removed by hydraulic giants, steam shovels, excavators, or other means. In the case of the hard-rock deposits, the rock is dug out by workmen using picks and shovels, while land pebble rock is usually mined by hydraulic methods. Dredging machines are sometimes used for the deposits under water.

After the rock is mined, it is washed and screened in order to separate the sand, clay, and small particles of phosphate rock and then thoroughly dried before shipping. The large pieces of phosphate rock are reduced in size in a crusher. Tennessee blue rock is not washed but the impurities are removed by a dry process.

Cost of mining.—The cost of mining phosphate rock depends upon a number of factors, most important of which is the depth of the overburden and the cost of removing it. In South Carolina no attempt is made to go much below a depth of 20 feet. In Florida, where a higher-grade rock is found, it is profitable to mine rock having an overburden of greater depth. According to data furnished by various companies, the cost of mining Florida land pebble rock, including washing, drying, etc., ranges from about $1.65 to $2.50 per gross ton, not including amortization of investment or royalties in case the mining is done on that basis, and the cost of mining Tennessee brown rock ranges from about $2.75 to $3.14 per gross ton, while the cost of mining rock in South Carolina is considerably higher. By reference to Table 45 (see p. 153) it will be seen that in 1913 and 1914 Florida phosphate rock sold in some cases below the actual cost of mining.

Section 6. Sulphuric acid.

Sulphuric acid is extensively used in the manufacture of fertilizer materials, particularly acid phosphate and sulphate of ammonia. As has already been indicated, some is also used for acidulating fish scrap and for digesting or dissolving low-grade ammoniates, such as waste hair, fur, felt, leather, feathers, wool waste, fleshings, garbage tankage, etc., in making base goods and proprietary tankages.

More than 60 per cent of the total output of sulphuric acid in the United States is used for fertilizer purposes. An estimate made by Utley Wedge, of the Tennessee Copper Co., in 1911 gave 73.8 per cent of the total production of sulphuric acid as being used for the manufacture of fertilizer, 9.2 per cent used in refining of petroleum products, 6.2 per cent used in iron, steel, and by-product coke industry, and the remainder in other industries. This estimate for the fertilizer industry appears to be somewhat too high. The total production of sulphuric acid in 1913, according to the figures of the Geological Survey, which are based on actual returns from producers, was 3,538,980 tons of 50° Baumé acid. Of this quantity approximately 2,000,000 tons were required for mixing with the 1,954,079 short tons of phosphate rock sold for domestic consumption in 1913, and 120,000 tons were required in making the 96,000 tons of sulphate of ammonia produced in 1913. It is difficult to estimate how much additional acid was used in making acidulated fish scrap, proprietary tankages, and base goods, but probably not less than 50,000 tons in the aggregate was consumed in this manner. The total quantity used in the manufacture of fertilizer materials would therefore amount to at least 2,170,000 tons, or about 60 per cent of the total production.

Process of production.—There are two important processes of making sulphuric acid—(1) chamber process and (2) contact process. The former process supplies about 90 per cent of the total annual production. In making sulphuric acid by either process brimstone, iron pyrites, or copper pyrites are roasted in order to obtain sulphur dioxide fumes. In the chamber process these fumes are oxidized through the agency of nitric-acid fumes, obtained by treating nitrate of soda with sulphuric acid, and hydrated by being mixed with steam or a fine spray. This process is carried on in large lead towers or chambers. About 900 pounds of Spanish pyrites and 15 pounds of nitrate of soda are used to produce a ton of 50° acid.

In the contact process the union of the sulphur dioxide with the oxygen of the air is accomplished by passing a mixture of the two through a porous mass of chemicals under appropriate conditions of temperature, velocity, etc. The oxidized fumes are then run into a weak solution of sulphuric acid, which hydrates them. By this process sulphuric acid to any degree of concentration can be made, whereas in the chamber process concentrated acid requires distillation.

The chamber process is used by the fertilizer manufacturers as well as by the copper and zinc smelting companies. The contact process is used only by chemical companies whose output is sold largely in concentrated form for special purposes.

Imported and domestic pyrites are largely used in obtaining the sulphur dioxide fumes, the imported pyrites coming from Spain and Portugal and containing from 45 per cent to 50 per cent of sulphur. The domestic pyrites are found in Virginia and various other States, the grades used averaging from 35 to 40 per cent of sulphur. The Tennessee copper ores are also rich in sulphur content.

Principal producers.—The fertilizer manufacturers are the largest producers of sulphuric acid. They have 136 plants in the United States equipped with acid chambers. Next to the fertilizer manufacturers are the chemical companies, the most important of which are the Davison Chemical Co., General Chemical Co., and The Grasselli Chemical Co. The first-named concern supplies a number of fertilizer plants located at Baltimore and other near-by points. A third class are the copper and zinc smelting companies which produce sulphuric acid as a by-product. The Tennessee Copper Co., Copper Hill, Tenn., and the Ducktown Sulphur, Copper & Iron Co. (Ltd.), Ducktown, Tenn., both have plants for converting the sulphurous fumes escaping from their smelters into sulphuric acid. There are also several smelting companies in the West producing sulphuric acid from smelter gases. The principal zinc companies making sulphuric acid as a by-product are the New Jersey Zinc Co. and its subsidiaries, with plants in Newark, Chicago, and other places. The copper and zinc smelters in 1913 produced 790,296 tons, or more than 22 per cent of the total of 3,538,980 net tons of 50° acid.

Sales of acid.—Sulphuric acid is often handled by brokers in fertilizer materials. Manufacturers also sell direct. Fertilizer manufacturers not only sell their surplus acid, but often exchange acid with one another when it is of advantage to do so. The output of the two Tennessee copper companies is sold under exclusive contracts to the International Agricultural Corporation. The Tennessee Copper Co. in 1912 and 1913, years in which the plant was in full operation, produced 192,084 and 197,713 tons, respectively, of 60° Baumé sulphuric acid, equivalent to more than 240,000 and 247,000 tons, respectively of 50° acid. The placing of this large quantity of acid on the market, which had to be disposed of mainly in the manufacture of acid phosphate, was one of the factors causing the decline of bulk acid-phosphate prices in 1912, 1913, and 1915. (See p. 154.)

CHAPTER V.

PRODUCTION AND SALE OF POTASH SALTS.

Section 1. Introduction.

Potassium is one of the three most essential elements of plant food in commercial fertilizers. It is especially necessary in the formation of starch, sugar, cellulose, and other carbohydrates. It also facilitates the growth of the fibrous or woody portions of the roots, leaves, and stems, and has a beneficial effect upon the maturity of crops, the flavor and quality of fruits, and the color of flowers. The term "potash," or "actual potash," is the commercial name for potassium oxide, which has the chemical designation K_2O. This compound, rather than the element potassium, has come to be generally used in the trade in analyzing and discussing potash salts.

The most available forms of potash are soluble salts, such as potassium carbonate, sulphate, and muriate. Upon the application of such salts to the soil the potash becomes immediately fixed in forms which are insoluble, but nevertheless available for plants. For this reason potash is not lost by leaching, but remains in the soil until used by plants.

Prior to 1887 more potash was used for industrial purposes than for agriculture, but since that date its use for fertilizer purposes has increased rapidly. In 1890, 58.4 per cent of the total consumption of German potash salts was for agricultural purposes; in 1900, 76.7 per cent; and in 1909, 87.4 per cent. The industrial uses of potash salts are mainly in medicines, paints, photography, dyeing, washing, bleaching, fireworks, gunpowder, matches, etc.

Sources of potash.—Most of the potash used for fertilizing purposes in the United States is imported from Germany. A small quantity is obtained from other sources, such as wood ashes, tobacco stems, cottonseed meal, the by-product pulp of beet-sugar factories, and the giant kelp along the Pacific coast. This last-named plant contains from 20 to 35 per cent of potassium chloride, but it has been used very little thus far as a source of potash.[1]

A large quantity of potash exists in the United States in various feldspar combinations, but these minerals are insoluble, and potash can be separated from the other elements only with difficulty.[2] Numerous experiments have been tried, especially with alunite, to separate the potash in some soluble form. Under the stimulus of the scarcity of potash salts caused by the European war this process is being rapidly perfected and it is reported that two concerns in Utah are already producing potash commercially from this source. Several concerns are also extracting potash in small quantities from feldspar.

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[1] See Fertilizer Resources of the United States, Senate Doc. No. 190, 62d Cong., 2d sess., pp. 40–42.

[2] Fertilizer Resources of the United States, p. 89.

A project is also under way by the American Trona Co. to mine potash salts at Searles Lake, Cal., and place them on the market in the near future. Searles Lake is a dry lake basin lying between the Slate and Argus ranges of mountains just south of the boundary line between Inyo and San Bernardino Counties. The potash is contained in the brine which is brought up from deep drillings sunk in the basin. It is estimated that the brine-saturated salt body is 60 feet thick, extending over an area of 11 square miles.[1]

Section 2. The German potash industry.

Importance of the industry.—The importance of potash in the agricultural world and the natural monopoly of production at present enjoyed by Germany has led to large investments of capital in the mining and refining industry. This has been especially the case since the enactment of the German law of 1910, which fixed the selling price of potash in such a manner as to insure a profit to the operator. The industry now represents an investment of 500 million marks ($119,000,000) in 193 mines (January, 1915), with a considerable number of others in the course of development.

The Prussian Government owns mines at Stassfurt, Bleicherode, and Vienenburg; the Duchy of Anhalt has large works at Leopoldshall; and the Duchy of Brunswick is also interested financially in the industry. Most of the mines, however, are privately owned.

Extent of deposits.—The principal crude potash salts mined in Germany are carnallit, kainit, sylvinit, and hartsalz. These minerals contain muriate of potash, mixed with various other salts, especially sodium chloride, which are of little or no value for fertilizer purposes. The deposits of these minerals are found a thousand feet or more below the surface, immediately above the rock-salt deposits. The different grades of crude potash salts lie in layers, one above the other, the carnallit stratum being the thickest.

The potash beds underlie a large area around Stassfurt and the Harz Mountains. The known deposits of potash extend from Mecklenburg on the north to Thuringia on the south, about 140 miles, and from Hanover on the west to the Russian border on the east, roughly 250 miles. In 1904 important deposits of potash salts were also discovered in Alsace while prospectors were boring for oil, and it was found that the beds underlie nearly 7 square miles and range from 6 to 30 feet in thickness. Several shafts have been sunk here for mining the salts. Still other deposits have been reported in Baden. It is estimated that the total German deposits of potash are sufficient to supply all the requirements of agriculture for several centuries.

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[1] Potash Salts, Summary for 1913, Geological Survey, II, 7, 1913, p. 88.

In no other country have as extensive and accessible deposits of potash salts been found as in Germany. It is stated that there are large deposits of such salts in Russia, but they are too deep to be mined profitably. Some low-grade deposits have also been found in Austria-Hungary, and one mine located near Kalucz in Galicia has been operated. Recently deposits have been found in Spain, but it will be some time before their extent and commercial value can be determined. Deposits have also been found in India, which may prove to be of importance.[1]

Growth of industry.—Potash salts were first discovered in Germany in 1857 while borings for rock salt were being made at Stassfurt near the Harz Mountains. The value of these salts as a fertilizer was discovered in 1860, and the first factory for refining crude potash was erected in 1861. In that year only 2,300 metric tons of crude salts were taken from the mines. In 1890, as shown by Table 31 following, the tonnage of the syndicate mines, which in that year comprised all the mines of the country, had increased to 1,279,264 metric tons, including kieserit, and in 1913 to 11,607,510 tons. Expressed in terms of actual potash (K_2O) this tonnage would, of course, be greatly reduced, as none of the unrefined salts contain more than 18 per cent of K_2O. However, in 1912, as shown by Table 32 following, the sales from the mines amounted to 1,009,219 metric tons of actual potash, and in 1913 to 1,110,369 tons. The value of these sales is estimated at $42,000,000 in 1912 and $45,500,000 in 1913.

TABLE 31.—TOTAL QUANTITIES OF CRUDE SALTS EXTRACTED FROM MINES OF THE GERMAN POTASH SYNDICATE, 1890–1913.[2]

Year.	Carnallit.	Kieserite.	Kainit, Hartsalz, and Schönit.	Sylvinit.	Total.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
1890	838,526	6,951	401,870	31,916	1,279,264
1895	782,944	3,012	669,531	76,097	1,531,585
1900	1,697,803	2,047	1,189,394	147,791	3,037,035
1901	1,860,189	2,335	1,432,136	190,034	3,484,694
1902	1,705,664	1,821	1,354,528	188,820	3,250,834
1903	1,844,036	1,553	1,582,867	196,140	3,624,597
1904	1,911,166	1,055	1,906,823	234,455	4,053,499
1905	2,239,709	2,730	2,405,536	230,621	4,878,598
1906	2,263,197	9,190	2,754,021	284,943	5,311,352
1907	2,534,788	10,359	2,788,973	304,143	5,638,261
1908	2,768,793	18,473	2,921,712	305,282	6,014,261
1909	3,280,726	7,387	3,268,290	344,749	6,901,153
1910	3,582,885		4,577,893		8,160,778
1911	4,441,664		5,264,843		9,706,507
1912	5,281,642		5,788,371		11,070,014
1913	5,302,350		6,305,160		11,607,510

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[1] The World's Supply of Potash, published by the Imperial Institute, London, 1915.

[2] Compiled from L'Engrais of July 3, 1914.

TABLE. 32.—TOTAL SALES OF PURE POTASH (K_2O) 1909–1913.[1]

Country.	1909	1910	1911	1912	1913
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Europe:					
Germany	359,241	418,744	479,839	528,565	604,283
Belgium	12,642	10,487	10,887	13,028	15,234
Holland	23,025	29,526	34,583	39,656	43,674
France	24,431	30,891	34,101	40,092	42,437
United Kingdom	22,872	24,727	26,784	30,017	29,419
Austria-Hungary	17,457	16,046	20,257	25,927	28,301
Italy	5,648	6,375	7,020	8,649	7,320
Scandinavia and Denmark	23,267	25,717	28,626	33,699	34,134
Russia and Baltic Provinces	10,298	15,982	18,895	25,320	24,568
Spain	5,188	7,410	9,914	9,071	8,355
Other countries	3,802	3,898	4,445	5,437	5,319
Total	507,871	589,803	675,351	759,461	843,044
North America, including Hawaii	161,062	258,386	251,859	233,087	248,295
Central America	121	168	257	352	370
South America	832	1,195	1,909	2,686	2,549
Africa	962	1,643	2,293	3,141	4,370
Asia (including East Indies)	3,029	4,862	6,410	7,836	9,194
Australia	1,454	1,826	1,848	2,656	2,547
Grand total	675,331	857,883	939,927	1,009,219	1,110,369

[1] These figures were compiled from L'Engrais of July 10, 1914. They include deliveries by companies not belonging to the German Potash Syndicate.

Mining and refining.—Some of the crude potash salts mined in Germany, especially kainit, are ground to powdered form and used for fertilizer without any refining. Carnallit is little used in this way except near the mines, because it absorbs water readily and is too expensive to transport. It is the principal source of muriate of potash and other refined salts. As mined, carnallit contains about 9 per cent of actual potash. In making muriate it is ground up and mixed in a dissolving vat with a boiling saturated solution of magnesium chloride. It is then concentrated until it shows 32° Baumé, when it is run out into settling vats from which the clear solution is drawn off into crystallizing vats and allowed to cool and to crystallize for several days. Manufactured muriate of potash is of various grades and potash content. For fertilizer purposes muriate is usually sold on the basis of 80 per cent muriate or 50.5 per cent actual potash.

Sulphate of potash magnesia, or double manure salt, was formerly made from kainit, but now is made by mixing muriate of potash with kieserit, a raw salt containing sulphate of magnesia, in a concentrated solution. It is sold on the basis of 48 per cent of actual potash. Sulphate of potash is derived from sulphate of potash-magnesia by adding a certain quantity of muriate. It varies from 90 to 96 per cent pure sulphate, which is equivalent to from 47 to 52.7 per cent actual potash. Single manure salt, now imported in two grades, 20 per cent and 30 per cent, is a partially refined salt containing muriate of potash. Hartsalz contains about 16 per cent pure potash and kainit about 12 per cent. Sylvinit is very similar to hartsalz and contains 17.4 per cent of actual potash.

Muriate of potash, kainit, and manure salt contain chlorides which are injurious to some crops, such as tobacco, oranges, etc. On such crops, sulphate of potash and sulphate of potash-magnesia, or double manure salt, which are free from such chlorides, are largely used.

Of the refined salts muriate of potash and sulphate of potash are used most extensively in the United States. Of the unrefined salts kainit is most generally used, though manure salt and hartsalz are imported in considerable quantities. No sylvinit has been imported since 1912.

Sulphate of potash, muriate of potash, double manure salt, and 30 per cent manure salt, all of which have been refined, are classed as concentrated forms and shipped to the United States in 200-pound bags; whereas 20 per cent manure salt, although partially refined, hartsalz, and kainit, are classified as crude salts and are shipped in bulk.

Section 3. The Potash Syndicate.

History.—Although the deposits of potash salts in Germany were discovered in 1857, and the first muriate factory was established in 1861, it was not until about 1875 that the mining of potash salts began on an important scale. Between that year and 1879 four mines and several muriate factories began operations. Competition among them became so severe that in February, 1879, they entered into an agreement to regulate the price of carnallit for five years, to fix the maximum quantity of crude salts to be produced, and to determine the distribution among the factories. The states of Prussia and Anhalt operated potash mines and became members of this combination. The following year, 1880, the agreement was extended to cover manure salts also.

In 1883 the entrance of the Aschersleben Kaliwerke, a powerful independent mine, into the field caused the dissolution of the first agreement and the formation in October of that year of another agreement for 4 years. This new agreement embraced all the mines and factories, included the regulation of the price of kainit for export, and fixed the quota of the five mines then in operation. By 1888 two more mines were operating, and the seven formed a combination for 10 years, which apportioned the output of the mines and handled sales through a syndicate or selling company.

Shortly afterward a propaganda bureau and a statistical bureau were created for Germany by the syndicate and later on similar bureaus were established in foreign countries, their duties being the distribution of potash literature and the encouragement of experimental work among farmers. By 1907 there had been 41 of these bureaus established, and prior to the outbreak of the European war, in 1914, there were 60 in operation.

From 1890 to 1900 the number of active mines increased to 15, some of which had not entered the syndicate, and in 1901 and 1902 the competition between them and the syndicate in the American market became so severe that prices were cut in half, and the independents were forced into the syndicate.

The agreement which came to an end on June 30, 1901, was renewed for three years, but only at the last moment, on account of dissensions among the members over their respective quotas. The agreement which expired in 1904 with even greater difficulty was renewed until June 30, 1909. In the meantime the syndicate or selling organization became a limited liability company.

All of the potash mines did not join the combination during the period from 1904 to 1909, and the syndicate itself had difficulty in keeping members from secretly breaking their agreement. The total number of mines increased from 15 in 1900 to 69 in 1910, and dissensions among members increased accordingly.

The syndicate agreement, which expired in 1909, contained a provision to the effect that members would be free to make independent contracts after June 30, 1909, if arrangements for renewing the combination were not made prior to that date. Efforts to complete such arrangements were unsuccessful, and on the night of June 30, 1909, one Schmidtmann, the owner of a controlling interest in two of the most important potash mines, Aschersleben and Sollstedt, entered into contracts with Robert Bradley, a representative of The American Agricultural Chemical Co., of New York, for the delivery of a large quantity of potash salts at much reduced prices. The contracts covered a period of two years, with the privilege of renewal for five years more, and called for deliveries of not less than 27,000 tons of potash (K_2O) annually. Subsequently these two mines made additional contracts with American buyers at the same prices as were agreed upon in the Bradley contracts. Through these contracts the two mines secured control of about 90 per cent of the total requirements of the United States for a period of seven years, the aggregate amount involved being about $35,000,000. The prices agreed upon in these contracts were from about 25 to 38 per cent less than the syndicate prices, and also even less than the actual cost of production of a number of mines. Muriate, for instance, cost $15.54 and kainit $1.92 per net ton f. o. b. mine under the Schmidtmann contracts, or $20.40 and $5.16, respectively, c. i. f. Atlantic ports, as compared with $32.98 and $7.03, respectively, charged by the syndicate. (See p. 155.)

In comparison with the Schmidtmann prices, the following figures given by Schönemann[1] for the average cost of producing muriate of potash by a number of mines are interesting. The averages are for the period 1901 to 1909, inclusive.

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[1] Schönemann, Die Deutsche Kali-Industrie und das Kaligesetz, p. 32.

Item.	Marks per 100 kilograms.	Dollars per net ton.
Average of 15 private mines (including amortization)	9.36	20.21
Average for the Prussian mines:		
Without amortization	7.94	17.14
With amortization	9.86	21.29
Fabrik Langelsheim:		
Without amortization	11.09	23.94
With amortization	12.86	27.77

It was asserted that if the Schmidtmann contracts were allowed to go into effect the weaker mines would be forced to close and the investment in them lost. At the same time the two Schmidtmann mines, with the greatly increased production and consequent reduction of cost, could operate profitably at these prices.

Immediately following the developments of June 30, 1909, negotiations were begun by the various mine owners looking to a renewal of the syndicate. A provisional syndicate was organized on July 24, which immediately set about to obtain a surrender of the Schmidtmann contracts. Schmidtmann was offered a large sum to cancel them, but he refused and, as stated above, entered into further contracts with American buyers. The syndicate then sought the aid of the German Government, and on May 25, 1910, the federal law concerning the sale of potash went into effect. The requirements of this act, as shown below, placed such a burden upon the American buyers that the Schmidtmann contracts were canceled and the syndicate was renewed upon a firmer footing than was possible before. The two Schmidtmann mines were forced to enter the syndicate, so that now it controls the entire output of potash salts by German mines and fixes prices and terms of sale in every consuming country. In 1914 the life of the syndicate was extended to 1925.

The potash law of May 25, 1910.—This law consists of a set of regulations governing the production and the sale of potash by German mine owners until the end of 1925. The following are the principal provisions of this law:[1]

(1) A so-called board of apportionment with a presiding officer and six members is created (sec. 30), which fixes the total quantity of potash to be sold by the owners of the mines during the calendar year as well as the proportion to be sold in the home market and abroad (sec. 7). It also fixes the maximum quantity of potash which each mine can sell during the calendar year, the quota for export being the same as the quota to be sold in the domestic market (sec. 8). In fixing the total quantity to be sold during the year this board of apportionment is required to make it at least as high as that fixed for the preceding year plus 5 per cent (sec. 7). The quotas for the

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[1] See R. Bielmann, Das Kaligesetz in der Praxis, Berlin, 1911.

mines are determined on the basis of the area and quality of the deposits of potash salts which have been opened up and on the capacity of the plant (sec. 9).

(2) Mines already in operation which sink additional shafts connected with the main shaft receive an addition to their allotments equal to 10 per cent of the average quotas of all mines (sec. 11).

(3) New mines as soon as they are ready to make deliveries receive a temporary quota for the first two years. This must not exceed 50 per cent of the average quota for all mines. At the end of two years a final quota is established. During the third year the mine is allowed 70 per cent of this figure, during the fourth year 80 per cent, and during the fifth year 90 per cent. At the beginning of the sixth year the full quota becomes effective (sec. 12). The limitation of the quotas of new mines during the first five years of operation does not apply to those mines in which the Empire or a constituent State owns or has as much as a third interest. They receive final participation figures as soon as the nature of the deposits and the operating conditions have been determined (sec. 12).

(4) With certain restrictions mine owners may transfer their allotments partially or entirely to other potash mines and exchange their right to sell separate kinds of salts among one another (sec. 19).

(5) The maximum prices at plant of the various salts sold in the domestic market are fixed by section 20. They range from 8.5 pfennigs per unit of potash (K_2O) for carnallit to 27 pfennigs for muriate and 35 pfennigs for sulphate of potash. The unit is 1 per cent of K_2O in 100 kilograms (220.5 pounds). From January 1, 1914, maximum prices will be determined every five years by the Bundesrat. An increase requires the consent of the Reichstag. Contracts made prior to April 17, 1910, are excepted from the regulations of sections 20–24 (sec. 45). The matter of allowances to purchasers of large quantities of potash salts and of discounts for cash payments is determined by the Bundesrat, and it is provided that all purchasers shall be entitled to organize associations in order to obtain these allowances and discounts (sec. 21).

(6) The sale of potash salts to foreign countries can be made only by proprietors of mines. All dealers and middlemen are excluded (sec. 4).

(7) The sale prices of potash delivered to foreign countries must not be lower than the prices fixed in section 20 for the home market except by consent of the Bundesrat (sec. 24).

(8) Every mine owner must pay a tax of 60 pfennigs per 100 kilograms of K_2O sold. The receipts are to cover the expenses of administration and propaganda work (sec. 27).

(9) All quantities sold in excess of the allotment are subject to a tax ranging from 10 marks per 100 kilograms of K_2O on the crude salts to 18 marks on the higher grade of refined salts (sec. 26).

(10) The Bundesrat is given authority to modify the excess taxes imposed by section 26 in the case of contracts concluded before December 17, 1909, so that the prices for quantities supplied after May 1, 1910, inclusive of taxes, will not exceed those prevailing up to June 30, 1909 (sec. 46).

(11) Heavy penalties are imposed for infractions of the law.

The potash controversy with the United States.—One of the purposes of the potash law of 1910 was to bring about the cancellation of the American contracts, which threatened the demoralization of the potash industry. It was held that if this industry were conducted upon a purely competitive basis, a wholesale dissipation of the valuable potash salts would result and that the temporarily low price of the Schmidtmann contracts would cause abandonment and waste of a large amount of invested capital. Till then the German Government had been satisfied with the elimination of competition by the efforts of the syndicate, but after the syndicate was no longer able to control the situation it was held that the Government should come to the rescue.

The cancellation of the American contracts was accomplished by section 26 of the new law, which imposed a heavy supertax on all production in excess of the regular allotments. The quantities of salts produced by the two independent mines in order to fill the American contracts were far in excess of their allotments, so that they were subject to heavy excess payments. They had protected themselves against such a contingency, however, by inserting in the contracts made with Americans a clause to the effect that the latter should pay any governmental charges that might be imposed. The excess tax was thereby shifted to the American purchasers. It increased the price of muriate of potash from $20.40 per net ton c. i. f. Atlantic ports to $40.50 per ton, which was about $5 higher than the syndicate price for American sales then in effect. The Americans, therefore, refused to accept deliveries under such conditions or accepted them under protest, and complications of various kinds arose, which it is not necessary here to discuss in detail. Prior to the passage of the potash law in 1910 the United States Government had begun negotiations with the German Government for the protection of American contracts, and after its passage it continued the negotiations with a view to effecting a settlement of the difficulties that had arisen, but was unsuccessful. In 1911, however, the American contractors and the potash syndicate finally reached a settlement. It was agreed that 60 per cent of the excess taxes paid by Americans between May 28, 1910, and June 1, 1911, aggregating $3,500,000, should be returned to them and that the American purchasers should enter into new contracts with the syndicate for their entire supplies of potash during the period covered by the Schmidtmann contracts. The two Schmidtmann mines relieved the American purchasers of their obligations upon payment of a certain sum in lieu of damages and reentered the syndicate. The sums due American purchasers in accordance with this settlement were voted by the Reichstag in 1914 and turned over to the syndicate for payment. Many of the American purchasers settled their claims by taking potash before the embargo was declared in 1915. The refund of the 60 per cent after deducting the costs of the lengthy litigation and the payments made to the independent mines for the surrender of the contracts brought the price of potash purchased during the 12 months' period of the Schmidtmann contracts down to a little less than what it would have cost the American manufacturers if purchased at the syndicate price.

Restriction of new mines.—The limitation of the allotment of new mines during the first five years made by section 12 of the German potash law was intended to prevent a too rapid expansion of the industry. In this respect the law has been a failure, for instead of preventing the uneconomical investment of capital in the industry, it has practically placed a premium upon new enterprises. After its passage in 1910 the number of new mines increased rapidly, until in January, 1915, there were 193 mines in operation, with a considerable number of others under development. Every allotment to a new mine decreases the quotas of old mines. The extent of the decrease is indicated by the fact that on January 1, 1909, 27 syndicate mines had a combined allotment equal to 48.4 per cent of the total production, whereas on July 1, 1913, the allotment of the same 27 mines had been reduced to 28.2 per cent. As a result of this reduction in quotas the productive capacity of all the mines now in operation is four or five times the quantity produced. In other words, the same quantity could be produced with from one-fourth to one-fifth of the present capital invested in the industry. The cost of operation per unit of potash is, of course, somewhat increased by the fact that mines are producing only up to a small part of their capacity.

The rapid increase in new mines since the passage of the potash law in 1910 led in 1914 to a movement to amend the law. A bill for this purpose was introduced in the Bundesrat and Reichstag. The potash syndicate was opposed to the idea, and to prevent action undertook to get all the mines to enter an agreement that they would sink no new shafts until 1920. In this it was unsuccessful. The principal features of the new bill are (1) an increase in the tax on production, part of which is to go into the imperial treasury and part into the propaganda fund; (2) an extension of the time in which a new mine can receive its complete quota from 5 to 10 years; and (3) the prohibition of the transfer of provisional quotas from one mine to another, which is permitted by section 19 of the present law.

Section 4. Sales of potash in the United States.

The United States consumes nearly one-fifth of the entire output of the German potash mines and more than one-half of the quantity exported from Germany. Approximately 95 per cent of the imports of German potash salts into this country is used for agricultural purposes and the remainder in the chemical and other industries. A large part of the quantity used for agricultural purposes is mixed with other materials by the fertilizer manufacturers and manipulators and sold to the trade in the form of mixed goods. A small quantity is sold to farmers who do their own mixing or apply the potash salts directly to the soil. During the period 1904–1913 the following quantities of the different salts have been imported for agricultural and for industrial purposes:

TABLE 33.—SHIPMENTS OF POTASH SALTS OF ALL KINDS TO THE UNITED STATES FOR FERTILIZERS AND FOR CHEMICAL PURPOSES, AND POTASH EQUIVALENT, 1904–1914.[1]

I. For fertilizer purposes.

Salt.	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Muriate:											
Salt	69,540	75,614	98,471	95,544	92,540	119,006	202,857	204,390	201,310	202,342	162,701
K_2O	35,159	38,230	49,787	48,309	46,790	60,172	102,569	103,344	101,787	102,308	81,350
Sulphate:											
Salt	14,539	16,870	21,598	22,225	21,242	30,134	36,961	47,937	41,012	33,120	26,983
K_2O	7,076	8,210	10,512	10,818	10,340	14,668	17,990	23,333	19,962	16,120	13,491
Double manure salt:											
Salt	12,821	11,562	13,196	9,854	13,511	12,681	12,867	15,991	15,277	15,221	13,117
K_2O	3,328	3,002	3,426	2,558	3,507	3,292	3,340	4,151	3,966	3,952	3,279
Manure salt, 30 per cent:											
Salt	4,064	10,160	10,160	10,160	10,160	8,839	13,533	12,565	11,095	11,988	9,364
K_2O	1,219	3,048	3,048	3,048	3,048	2,652	4,137	3,927	3,528	3,665	2,809
Manure salt, 20 per cent:											
Salt	58,176	41,046	50,664	50,092	42,571	50,953	106,493	133,867	133,856	197,071	117,647
K_2O	11,635	8,209	10,133	10,018	8,514	10,190	21,319	26,773	26,771	39,414	23,529
Kainit:											
Salt	302,760	385,794	421,633	367,714	347,392	404,611	592,274	502,804	440,212	445,706	173,053
K_2O	37,542	47,838	52,283	45,597	43,077	50,172	73,442	62,349	54,586	55,268	21,632
Sylvinit and hartsalz:											
Salt	3,087	2,998	18,689	12,627	13,813	45,621	138,203	84,771	35,280	[3] 37,626	12,795
K_2O	576	554	2,999	2,022	2,213	7,332	22,112	13,563	5,645	[3] 7,825	2,047
Total:[2]											
Salt	464,987	544,044	634,411	568,216	541,229	671,845	1,103,188	1,002,325	878,042	943,074	515,660
K_2O	96,535	109,091	132,188	122,370	117,489	148,478	244,909	237,440	216,245	228,552	148,137

II. For chemical purposes.

Salt.	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Muriate:											
Salt	18,448	14,472	17,661	16,293	11,006	16,671	16,869	22,361	26,731	21,594	15,007
K_2O	9,327	7,317	8,929	8,238	5,565	8,429	8,529	11,306	13,516	10,905	7,503
Sulphate:											
Salt	1,397	1,426	805	710	772	485	769	467	768	643	430
K_2O	680	694	392	346	376	236	374	227	374	313	215
Total:[2]											
Salt	19,845	15,898	18,466	17,003	11,778	17,156	17,638	22,828	27,499	22,237	15,437
K_2O	10,007	8,011	9,321	8,584	5,941	8,665	8,903	11,533	13,890	11,218	7,718
Grand total:[2]											
Salt	484,832	559,942	652,877	585,219	553,007	689,001	1,120,826	1,025,153	905,541	965,311	531,097
K_2O	106,542	117,102	141,509	130,954	123,430	157,143	253,812	248,973	230,135	239,770	155,855

[1] Taken from the Potash Supply with Special Reference to the United States, pp. 40 and 41.

[2] These totals, obained by addition, differ slightly from those given in the original.

[3] Hartsalz only.

The total quantity of potash salts shipped for fertilizer purposes in 1910 was larger than for any other year shown in the table. The shipments for fertilizer purposes in 1913 were 943,074 tons, or more than 160,000 less than in 1910. The shipments for chemical purposes were largest in 1912.

The five fertilizer contracts.—Almost all of the potash salts consumed in the United States for fertilizer purposes have been imported in the first instance on five large contracts with the Potash Syndicate, the parties to the individual contracts being The American Agricultural Chemical Co., New York, N. Y.; International Agricultural Corporation, New York, N. Y.; Wilson & Toomer Fertilizer Co., Jacksonville, Fla.; Armour Fertilizer Works, Chicago, Ill.; and Virginia-Carolina Chemical Co., Richmond, Va. These contracts were made in May, 1911, as a result of the settlement of the so-called potash controversy and were to remain in effect until December 31, 1916, but were suspended shortly after the outbreak of the European War.

The policy of the syndicate in offering large discounts to the fertilizer manufacturers who purchased annually quantities in excess of 20,000 tons of pure potash equivalent (K_2O) resulted in the combining of orders under the five contracts mentioned. In one case 47 companies made an arrangement whereby one of them, the Wilson & Toomer Fertilizer Co., Jacksonville, Fla., made the main contract with the syndicate and the other 46 entered into subcontracts with Wilson & Toomer. The number of these subcontracts had grown in 1914 to 52.

Somewhat similarly the contract of the International Agricultural Corporation carried 18 subcontracts, and that of The American Agricultural Chemical Co. carried two. Neither the contract of the Armour Fertilizer Works nor that of the Virginia-Carolina Chemical Co. carried any subcontracts, but the former arranged to supply Swift & Co., Chicago, Ill., and the F. S. Royster Guano Co., Norfolk, Va.

Because of the discounts allowed under the large contracts, it seemed at first as if the parties to them were destined to enjoy a decided advantage over those who depended upon the market for their supplies. For a short time prices on potash purchased by manufacturers not parties to the contracts were but little below the syndicate's list price; but those contracting parties who had a surplus to sell gradually began cutting the price in competition among themselves until they were selling at about 11 or 12 per cent off the list price, as against the 15 and 15½ per cent discount which they received. This surplus was largely disposed of through brokers, but no fertilizer broker or even dry-mixing concern was permitted to make a subcontract to one of the five large contracts.

In addition to sales on these 5 fertilizer contracts the syndicate sold to farmers through its propaganda agency in this country, the German Kali Works, and also had 10 contracts with chemical companies in the United States. The quantities of various potash salts sold in the United States in 1913 through these three separate channels are given in the table below:

TABLE 34.—TOTAL QUANTITIES OF POTASH SALTS SOLD IN THE UNITED STATES BY THE GERMAN POTASH SYNDICATE ON THE FIVE FERTILIZER CONTRACTS, THROUGH THE GERMAN KALI WORKS AND TO CHEMICAL COMPANIES, CALENDAR YEAR 1913.

Company.	Sulphate.	Muriate.	Double manure salt.	Manure salt, 30 per cent.	Manure salt, 20 per cent.	Hard salt.	Kainit.	Total (in terms of K_2O).
	Net tons.	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*
Wilson & Toomer Fertilizer Co....	9,559	57,723	8,190	600	50,018	12,708	115,041	61,707
The American Agricultural Chemical Co..........................	7,172	50,080	2,858	11,388	38,045	2,022	60,624	47,962
International Agricultural Corporation..............................	6,042	33,808	2,336	....	21,325	20,304	124,987	43,020
Armour Fertilizer Works..........	6,298	29,503	1,466	....	62,469	2,330	34,497	35,270
Virginia-Carolina Chemical Co....	2,875	23,264	371	....	25,214	....	93,385	29,409
Total on five contracts......	31,946	194,378	15,221	11,988	197,071	37,364	428,534	217,368
German Kali Works..............	1,174	7,964	....	....	....	262	17,172	6,670
Total for fertilizer purposes..	33,120	202,342	15,221	11,988	197,071	37,626	445,706	224,038
Chemical companies [1]............	643	21,594	....	....	....	....	....	11,119
Grand total................	33,763	223,936	15,221	11,988	197,071	37,626	445,706	235,157

[1] The syndicate also sold to these companies 11,049 tons of kieserite, which contains no potash.

Terms of sale.—The prices and terms of sale of potash salts in the United States were fixed by the syndicate and contained in the five contracts with American purchasers. The base price of muriate in 1914 was fixed at $39.07 per ton of 2,000 pounds; of bulk kainit, $8.36 per ton; of manure salts, 20 per cent, $13.58; and of sulphate, $47.57. There was allowed on the five large contracts a discount of 1½ per cent for cash, and a further discount of 13½ per cent for concentrated salts and 14 per cent for crude salts, because they were for quantities containing 20,000 tons or more of actual potash (K_2O). These discounts were allowed only to fertilizer manufacturers. On orders of at least 15,000 tons of actual potash the syndicate allowed 10 per cent discount on concentrated and 10½ per cent on crude salts; on 10,000 tons, 7 per cent on the one and 7½ per cent on the other; on 5,000 tons, 5 per cent and 5½ per cent, respectively; while on 1,000 tons, 3 per cent and 3½ per cent, respectively, were allowed. As noted above, however, the consumer could purchase such supplies at a lower price from the large importers, and no doubt the syndicate was willing to be relieved of carrying numerous contracts for small deliveries.

One-half of the maximum discount received on each of the five large contracts was deducted from the amount of the invoice covering each shipment, and the remainder was paid to the buyer at the end of each half year, provided he made a statement in writing to the syndicate or its representative in the United States to the effect that he had purchased his entire requirements of potash from the syndicate or from others who had bought exclusively from the syndicate. The same conditions were not imposed upon the smaller discounts for shipments of less than 20,000 tons of actual potash.

The prices fixed by the syndicate for the United States included cost, insurance, and ocean freight to the United States ports. The purchaser, however, was required to pay for each shipment before sailing and to take title to the cargo on vessel in one of the principal ports of Germany, Holland, Belgium, or France. The freight was deducted by the syndicate from the invoice and paid by the American buyer upon the arrival and discharge of the vessel at the port of destination.

The buyer was required to give the syndicate, at least five weeks in advance of shipment, letters of credit on banks or bankers in Hamburg or Berlin approved by the syndicate to an amount at least equal to the amount of the invoice less freight and discounts.

Prior to April 1 of each year, or a later date set by the syndicate and known as the " booking date," the buyer had to furnish the syndicate or its representative in the United States with a detailed statement of his requirements of potash salts during that calendar year. If this statement was not made within the prescribed time, the buyer was penalized 50 cents a ton on concentrated salts and 20 cents a ton on crude salts. At any time prior to July 31 the buyer could order salts in addition to the quantities detailed in the statement at the full discount; but after July 31, the final "booking date" for the year, any additional orders had to pay an extra sum of 50 cents per ton on concentrated salts and 20 cents a ton on crude salts. The buyer had to order his potash salts, calculated in actual potash, for shipment in eight approximately equal monthly quantities covering the months from May to December. He could not order less than 200 tons of bulk goods and 50 tons of bagged goods for each shipment.

The buyer had to accept the syndicate's weights and analyses, but was allowed to maintain at his own expense a representative in Germany to check the weighing and sampling. Certificates of weights (for crude salts only) and of analyses accompanied the bills of lading. The syndicate guaranteed a certain minimum of potash for each salt. If in the case of crude salts the analysis showed a quantity less than the minimum, the syndicate agreed to allow 75 cents for each 1 per cent of actual potash or fraction of a per cent that was lacking.

German Kali Works.—The German Kali Works is the propaganda agency of the German Potash Syndicate in the United States. It is incorporated under the laws of the State of New York and has headquarters in New York City. This agency publishes and distributes literature concerning the use and importance of potash salts and the feasibility of home mixing for the farmer. It also cooperates with agricultural colleges and societies and with experiment stations for the purpose of increasing the consumption of potash salts in the United States.

In addition to its propaganda work, the German Kali Works sells potash salts directly to the farmer, and also, from time to time, renders assistance to manufacturers who get their supplies from the syndicate but who have need in an emergency of an immediate delivery. In like manner the German Kali Works itself purchases from the manufacturers when its needs can be more conveniently served by so doing. Prior to 1911 this agency also sold all kinds of fertilizing materials, but by the terms of settlement of the potash controversy the Potash Syndicate agreed not to sell any fertilizers in the United States except potash salts until after the expiration of the five contracts at the end of 1916. The German Kali Works has branch offices at Baltimore, Md.; Chicago, Ill.; Savannah, Ga.; Wilmington, N. C.; and New Orleans, La., and distributing warehouses at other points.

CHAPTER VI.

WHOLESALE PRICES OF FERTILIZER MATERIALS.

Section 1. Introduction.

In this chapter are given tables of wholesale prices, diagrams of price movements, and explanations of price fluctuations for all the principal fertilizer materials, namely, nitrate of soda, sulphate of ammonia, cottonseed meal, tankage, dried blood, fish scrap, acid phosphate, phosphate rock, and various potash salts.

The domestic prices used in the tables and charts have been obtained from producers of materials, fertilizer brokers, and fertilizer manufacturers. Wherever possible the figures for a given material have been obtained from two and sometimes three different sources, so that by comparison possible errors might be eliminated. The foreign prices used in the tables are from trade journals, and in most cases have been taken from several sources and compared. Average monthly prices, covering as many years of the last decade as it was possible to obtain accurate data, have been computed. The conclusions given are applicable to the years prior to July 1, 1914.

Price fluctuations.—The prices of nitrates and ammoniates used for fertilizer show much more frequent and much sharper fluctuations than the prices of phosphates and potash salts. During the period covered by the tables several marked movements have occurred in the prices of both the organic and inorganic nitrogenous materials. These fluctuations have been by no means uniform for both groups. For instance, during the year 1912 the prices of nitrate of soda and sulphate of ammonia showed an upward trend, culminating in the highest prices reached in a decade, while the prices of tankage, dried blood and fish scrap showed a downward trend, reaching a lower point than had been seen since the summer of 1908. During the year 1913 just the opposite movements occurred. The prices of nitrate of soda and sulphate of ammonia showed a declining tendency throughout most of the year, while the prices of the organic ammoniates except cottonseed meal, beginning in August, rose sharply, culminating in the spring of 1914 in higher prices than had ever been quoted before.

In contrast with these rapid price movements of the nitrates and ammoniates, the prices of Florida phosphate rock and acid phosphate moved slowly but almost steadily downward for a number of years, while the prices of potash salts remained constant except when changed by the potash syndicate.

Causes of price fluctuations.—Except for potash salts, the wholesale prices of which are purely arbitrary owing to monopolistic control of a natural resource, the price fluctuations noted hereinafter appear to have been governed fundamentally by the law of supply and demand. There have been, however, temporary artificial influences, such as speculation and manipulation, which have sometimes affected the prices of these fertilizer materials. In the case of nitrate of soda and sulphate of ammonia, which together supply a large part of the nitrogen used in agriculture, the factors affecting prices are world-wide, necessitating a study of conditions not only in the United States, but in the principal world markets.

As is shown in following sections the number and the quantity of potentially available materials used as a source of nitrogen and the diversified interests supplying them, make it extremely difficult to maintain the price of any one of them by artificial means for more than a brief period of time. An advance in price of one material will usually lead to a substitution of others which are cheaper. The substitution of one inorganic material for another, such as sulphate of ammonia or some of the air nitrates, for nitrate of soda, or of one organic ammoniate for another, such as cottonseed meal for tankage or dried blood, is readily made because of the similarity of their nitrogen content both in availability and action. And the substitution of an organic for an inorganic material will also be made to considerable extent if the difference in price offers sufficient inducement, notwithstanding the difference in the availability and action of their nitrogen content. In 1912, for instance, cottonseed meal was apparently substituted for nitrate of soda on a considerable scale in cotton-growing States, owing to the relative cheapness of the former.

This variety and interrelation of the nitrates and ammoniates is, therefore, a very important factor in regulating prices. Because of this factor, it has been impossible for the producers of nitrate of soda, which is wholly supplied from Chile, to exact monopoly prices, though this is possible for the German Syndicate for potash salts, because there is no available substitute. For the same reason, it has been impossible for the American Coal Products Co., which controls the sale of about 90 per cent of the sulphate of ammonia produced in the United States, to maintain an unduly high price for domestic sulphate, or for the packers of this country to maintain the prices of tankage and dried blood at an artificially high level for any great length of time.

A further difficulty which any organized attempt to control the prices of nitrogenous materials would encounter is the fact that with proper methods of agriculture it is possible for a farmer to dispense entirely with such fertilizers. By planting cowpeas, clover, beans, and other leguminous crops and plowing them in, the fertility of any soil capable of growing these crops as far as the element of nitrogen is concerned, can be maintained without the assistance of prepared fertilizers, but such a substitution would, of course, necessitate a readjustment of the farmer's methods and a careful rotation of crops.

There are not as many sources of phosphorus as of nitrogen, phosphate rock and basic slag being the two most important; but the extensive deposits of phosphate rock in the United States as well as in various other parts of the world, and the extensive deposits of phosphorus-bearing iron ore from which, especially in Europe, basic slag is obtained, make it difficult to raise prices unduly through monopoly control of the sources of raw materials. Sulphuric acid is also a product difficult to monopolize on account of the simplicity of process and abundance of pyrites from which it is made. The prices of bulk acid phosphate for some time have been very low, owing to overproduction, which has been caused not only by the excessive mining of phosphate rock, but especially by the overproduction of sulphuric acid.

Potash salts are the only fertilizer materials the wholesale prices of which have been arbitrarily controlled. This is possible because competition among the German mine owners is prevented by law and there are no important sources of potash at present developed in any other country.

Section 2. Nitrate of soda.

For the purpose of studying the price fluctuations of nitrate of soda, average monthly spot prices[1] have been taken for five principal receiving markets, viz, New York, Liverpool, Hamburg, Antwerp, and Dunkirk, and also for the Chilean market of exportation. These prices are presented in Table 35 and are also shown graphically in Diagram 1, opposite page 124. The average prices for New York were computed from actual spot transactions of W. R. Grace & Co., the largest American importer; those for the European markets were obtained from L'Engrais (Paris) and the Chemical Trade Journal and Chemical Engineer (London), and those for Chile from the weekly trade circulars published by Weber & Co. and Jackson Bros., of Valparaiso, and from figures published by the Nitrate Propaganda Association. The figures obtained from these published sources show but slight deviation from corresponding figures presented in other publications.

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[1] Spot prices are for transactions where delivery is immediate.

TABLE 35.—AVERAGE MONTHLY SPOT PRICES PER 100 POUNDS OF NITRATE OF SODA IN THE PRINCIPAL WORLD MARKETS, 1906–1914.

Month.	On the coast of Chile alongside vessel.	Dunkirk, France.[1]	Antwerp, Belgium.[1]	Hamburg, Germany.[1]	Liverpool, England.[2],[3]	New York, N. Y.[2]
1906—January	$1.90	$2.20	$2.19	$2.23	$2.39	$2.16
February	1.87	2.20	2.20	2.25	2.40	2.23
March	1.84	2.26	2.26	2.29	2.44	2.23
April	1.92	2.35	2.35	2.35	2.47	2.27
May	1.94	2.32	2.37	2.27	2.50	2.28
June	1.93	2.20	2.18	2.14	2.47	2.23
July	2.06	2.26	2.24	2.20	2.44	2.26
August	2.21	2.31	2.33	2.30	2.45	2.47
September	2.26	2.43	2.43	2.41	2.52	2.51
October	2.28	2.50	2.50	2.43	2.56	2.56
November	2.19	2.44	2.40	2.36	2.49	2.57
December	2.09	2.29	2.29	2.33	2.44	2.52
1907—January	1.97	2.29	2.29	2.32	2.44	2.42
February	2.00	2.30	2.29	2.32	2.46	2.50
March	2.07	2.35	2.36	2.38	2.50	2.52
April	2.07	2.31	2.34	2.37	2.48	2.60
May	2.11	2.22	2.22	2.20	2.38	2.55
June	2.13	2.29	2.29	2.29	2.38	2.50
July	2.11	2.30	2.32	2.30	2.39	2.45
August	2.14	2.33	2.32	2.33	2.40	2.35
September	2.13	2.35	2.33	2.32	2.39	2.35
October	2.13	2.35	2.32	2.30	2.44	2.38
November	1.97	2.31	2.30	2.25	2.41	2.36
December	1.98	2.30	2.30	2.27	2.44	2.43
1908—January	1.99	2.32	2.31	2.32	2.44	2.41
February	1.96	2.30	2.31	2.32	2.44	2.43
March	1.83	2.21	2.22	2.25	2.42	2.36
April	1.81	2.05	2.07	2.07	2.31	2.32
May	1.78	2.02	2.01	2.01	2.20	2.30
June	1.73	1.97	1.96	2.02	2.13	2.26
July	1.77	1.97	1.98	2.00	2.17	2.25
August	1.77	1.97	1.98	1.97	2.17	2.23
September	1.71	1.96	1.91	1.91	2.16	2.18
October	1.76	1.96	1.93	1.92	2.08	2.15
November	1.77	1.98	1.96	1.95	2.08	2.15
December	1.77	2.01	1.97	1.99	2.09	2.18
1909—January	1.71	1.97	1.95	1.96	2.06	2.18
February	1.68	1.95	1.95	1.93	2.07	2.16
March	1.68	2.09	2.09	2.10	2.18	2.16
April	1.64	2.16	2.17	2.22	2.24	2.14
May	1.63	2.20	2.21	2.26	2.27	2.17
June	1.65	2.08	2.06	2.07	2.25	2.16
July	1.66	1.92	1.92	1.91	2.15	2.12
August	1.64	1.92	1.91	1.87	2.08	2.13
September	1.64	1.92	1.91	1.85	2.05	2.12
October	1.61	1.87	1.84	1.82	2.01	2.11
November	1.65	1.86	1.82	1.83	2.01	2.08
December	1.63	1.85	1.83	1.85	2.01	2.10
1910—January	1.55	1.83	1.82	1.82	2.00	2.09
February	1.55	1.87	1.86	1.85	2.00	2.09
March	1.56	2.00	1.98	1.94	2.09	2.12
April	1.55	1.92	1.92	1.95	2.10	2.14
May	1.59	1.78	1.80	1.82	2.04	2.13
June	1.67	1.84	1.86	1.89	2.05	2.13
July	1.62	1.85	1.86	1.86	2.00	2.12
August	1.71	1.89	1.90	1.90	2.02	2.11
September	1.75	1.93	1.93	1.91	2.04	2.12
October	1.74	1.93	1.92	1.92	2.04	2.13
November	1.73	1.92	1.92	1.90	2.04	2.12
December	1.70	1.94	1.94	1.93	2.05	2.11
1911—January	1.71	1.99	1.99	1.97	2.06	2.10
February	1.69	2.00	2.01	2.00	2.11	2.10
March	1.65	2.03	2.04	2.04	2.10	2.09
April	1.67	2.04	2.06	2.08	2.12	2.10
May	1.70	2.01	2.06	2.04	2.14	2.12
June	1.73	2.02	2.05	1.99	2.16	2.13
July	1.79	2.03	2.05	2.01	2.16	2.16
August	1.82	2.04	2.05	2.02	2.15	2.17
September	1.86	2.05	2.05	2.03	2.16	2.22
October	1.90	2.09	2.08	2.08	2.19	2.23
November	1.87	2.10	2.08	2.07	2.20	2.21
December	1.79	2.10	2.08	2.10	2.20	2.19

[1] Quotations for Continent are for cargo lots.
[2] Quotation for Liverpool and New York, less than cargo lots.
[3] Less 2½ per cent for cash.

TABLE 35.—AVERAGE MONTHLY SPOT PRICES PER 100 POUNDS OF NITRATE OF SODA IN THE PRINCIPAL WORLD MARKETS, 1906–1914—Continued.

Month.	On the coast of Chile alongside vessel.	Dunkirk, France.	Antwerp Belgium.	Hamburg, Germany.	Liverpool, England.	New York, N. Y.
1912—January	$1.77	$2.10	$2.10	$2.10	$2.18	$2.20
February	1.77	2.14	2.14	2.15	2.25	2.23
March	1.77	2.29	2.33	2.32	2.38	2.30
April	1.80	2.30	2.32	2.31	2.40	2.40
May	1.89	2.22	2.24	2.21	2.40	2.40
June	1.91	2.28	2.31	2.28	2.39	2.48
July	1.96	2.30	2.29	2.25	2.39	2.46
August	2.06	2.32	2.33	2.32	2.44	2.47
September	2.08	2.38	2.43	2.39	2.48	2.54
October	2.06	2.38	2.43	2.38	2.52	2.56
November	2.05	2.42	2.42	2.40	2.55	2.60
December	1.96	2.37	2.38	2.36	2.52	2.60
1913—January	1.96	2.44	2.43	2.46	2.53	2.58
February	1.98	2.51	2.54	2.55	2.61	2.62
March	1.93	2.50	2.55	2.54	2.61	2.62
April	1.88	2.42	2.48	2.47	2.58	2.61
May	1.84	2.25	2.29	2.28	2.43	2.47
June	1.83	2.20	2.21	2.16	2.33	2.43
July	1.83	2.13	2.15	2.14	2.28	2.33
August	1.89	2.19	2.19	2.19	2.31	2.32
September	1.89	2.22	2.24	2.21	2.33	2.31
October	1.88	2.23	2.21	2.18	2.32	2.26
November	1.86	2.17	2.18	2.13	2.28	2.25
December	1.91	2.20	2.20	2.20	2.28	2.23
1914—January	1.87	2.20	2.20	2.18	2.26	2.22
February	1.88	2.23	2.23	2.19	2.28	2.25
March	1.83	2.24	2.23	2.24	2.30	3.25
April	1.80	2.09	2.10	2.07	2.23	2.24
May	1.79	2.07	2.08	2.06	2.16	2.14
June	1.78	2.17	2.18	2.07	2.14	2.13

Price fluctuations.—By reference to Table 35 and Diagram 1 three major movements in the price of nitrate since 1906 will be noted, aside from numerous minor fluctuations. During the first movement prices in all six markets moved from the high point reached in the fall of 1906 almost steadily downward until the spring of 1910. The one important reaction occurred in the European markets in the spring of 1909 when the price went sharply upward, largely on account of a widespread belief (due to reports of European scientists) that the nitrate deposits would soon be exhausted. To counteract this impression the Chilean Government made surveys of the whole nitrate territory and issued reassuring statistics as to the longevity of the yield. The New York and Chile prices were only slightly affected by the sudden rise in Europe.

From the first half of 1910 until the spring of 1913, when the second major movement ended, prices in the receiving markets rose almost continuously, finally surpassing the high prices of 1906 and 1907 in every market except the Chilean. The prices on the coast of Chile did not follow the general trend as closely as usual. They took a downward turn during the last half of 1910 and the first quarter of 1911, and also a sharp break beginning in November, 1911, which continued into the following year, the upward trend not being resumed until April, 1912. This upward movement, moreover,

culminated in September, 1912, nearly six months before the highest prices were reached in the other markets.

Beginning in March, 1913, prices declined sharply, especially in the receiving markets. There was a brief upturn beginning about the 1st of August, 1913, anticipating the formation of a combination of producers to restrict output, after which prices continued to decline, reaching $2 per 100 pounds in the Hamburg market in July, 1914, as compared with $2.54 in March, 1913. There was a still further decline after the outbreak of the European war, but by the end of October, 1915, prices had risen to $2.90 per 100 pounds.

By reference to the diagram it will be seen that the prices in the New York and Liverpool markets are usually higher than the prices in the continental European markets. This difference in price is explained in part at least by the fact that the prices in the continental markets are for cargo lots, while those for New York and Liverpool include smaller quantities. Another factor is the higher cost of importation to the United States over Europe. Charter rates to the United States are always higher, owing to the uncertainty of a return cargo. Sailing vessels which help to keep down steam charter rates to European ports, especially Hamburg, can not be induced to come to the United States.

Causes of major price fluctuations.—The price of nitrate of soda is fixed in the European market where its consumption for agricultural purposes is heaviest and where it enters into competition with sulphate of ammonia, cyanamid, and other air nitrates. Prices in the United States and on the coast of Chile follow the prices in the European market. The most important factor affecting the price of nitrate (see p. 28), is the maladjustment between supply and demand. The demand for nitrate is not only seasonal, but varies from year to year in different countries according to weather, crop, and other conditions. The demand in European countries, which are the largest consumers, is somewhat responsive to conditions in the beet-sugar industry. This is shown by the last part of the diagram. The supply of nitrate reaching the European market is stimulated by high prices and restricted by low prices. The distance from the coast of Chile to the European markets and the uncertainty of adequate vessel tonnage and of stable charter rates serve to increase the maladjustment between supply and demand. The lack of adjustment makes the sale of nitrate a peculiarly speculative business. The profits of the middlemen depend to a considerable extent upon their ability to correctly judge the future course of the primary and secondary markets.

The various factors which affect the supply of, and demand for, nitrate of soda in the world's markets may best be described by a study of the last important rise in price which culminated in the spring of 1913 and the subsequent decline in price which followed. For two years preceding the rise prices had been at a low level, thus exerting a restrictive influence upon the quantity produced. The number of oficinas in operation decreased from 118 in the fall of 1907 to 66 in March, 1909. The steadily increasing cost of mining due to a scarcity of labor in Chile caused by the abnormal demand in the building of new railroads, the opening of copper mines, etc., the increased cost of fuel, and the decreasing yield of the caliche mined also tended to discourage production. During this period of rising prices there was no combination of producers to artificially restrict output, so that this factor which at times has exerted at least a temporary influence upon prices need not be considered. The export tax also was constant, and other charges, such as for railroad transportation, commissions, etc., remained practically the same during the period in question.

The low prices of the years 1909 to 1911, which tended to restrict output, also stimulated a demand for nitrate of soda in the consuming markets. This demand was further stimulated by the increased activity of the propaganda association. As is shown in Chapter II (see p. 22) world consumption, compared with the preceding year, increased approximately 11 per cent in 1909 and 15 per cent in 1910, years of low prices, while in 1912 and 1907, when prices were high, the increase over the preceding year was only 5 per cent and one-half of 1 per cent, respectively.

The year 1911 saw very high prices for sugar in the world's markets. This led to heavy sowings of sugar beets in Europe in 1912 and a greatly increased use of nitrate of soda for fertilizer. Germany consumed 180,000 net tons more than she did the year before, and the rest of Europe showed similar increases. Stocks on hand were thereby depleted. For the first time in many years the visible supply in all markets at the end of 1912 was less than that of the preceding year. (See p. 22.)

The great expansion in international trade throughout the world in 1912 led to a sudden shortage of vessel tonnage and consequent high charter rates. For more than 10 years sailing-vessel rates on nitrate to European markets had remained under $2.50 per ton, but in 1912 they rose to as high as $6.40. The shortage of vessel tonnage was more pronounced than ever before, owing to the fact that the low ocean rates that had prevailed for a number of years and the competition of steam vessels had discouraged the building of sailing vessels and caused a transfer of capital to more remunerative fields. The Balkan war and the labor troubles in England and Australia also resulted in tying up a considerable number of vessels, while many of them were drawn away from Chile to the Argentine in anticipation of a bumper wheat crop. It is said that 600 vessels were held up in the Dardanelles on account of the Balkan war. The coal strikes in England also restricted the production of sulphate of ammonia and caused a sharp rise in price. (See p. 136.) This stimulated the demand for nitrate of soda. Thus, while Europe was demanding increased quantities of nitrate the exporters were unable to obtain sufficient vessels in which to transport it to market, and for those that they were able to obtain they were obliged to pay abnormally high ocean rates. The conditions above noted were particularly favorable for manipulating the market. Apparently, two Hamburg concerns took advantage of this situation and cornered a considerable part of the available supply of nitrate in Europe, and as shipments were not being received rapidly enough to satisfy the demand they were able to force prices up to an abnormally high level for a few months. The Chemical Trade Journal and Chemical Engineer of January 25, 1913, intimates that these exporters took advantage of the extra "surf days" and "lay days" to delay the loading of cargoes in Chilean ports in order to profit by the scarcity of nitrate in Europe.

Europe depends for nitrogen to a much larger extent than America upon inorganic nitrates and ammoniates, especially nitrate of soda and sulphate of ammonia. It has been stated that these two materials dominate the market for nitrogen in Europe. Their prices usually follow the same general trend. At the beginning of 1912 the price of a unit of nitrogen in sulphate of ammonia in the European markets was considerably higher than that in nitrate of soda. (See p. 137.) This situation was not reversed until about September 1, so that prior to this date the price of sulphate of ammonia was favorable to a rise in the price of nitrate of soda owing to the substitution of the cheaper material. The output of air nitrates was not large enough in that year to have any noticeable effect on the market, but the stimulus of the high prices resulted in a large increase in their production in 1913.

The decline in the price of nitrate of soda which began in March and April, 1913, and which continued with only an occasional reaction down to January, 1915, was due to causes which were just the reverse of those leading to the rise of 1912. The period of rising prices caused a falling off in consumption in the European market, on the one hand, and the opening of new oficinas and increased production on the other. The high ocean freights stimulated the building of steam vessels, and when business began to ebb a surplus of vessel tonnage was brought about, freight rates dropped rapidly and the consuming markets became overstocked with nitrate.

As noted above, the price of a unit of nitrogen in sulphate became cheaper than of a unit in nitrate as early as September, 1912, and thereafter by substitution tended to bring down the price of the latter. The high prices of Chilean nitrate of soda also stimulated the production of air nitrates, so that in 1913 large quantities of these materials came into the European market in competition with nitrate of soda and were freely substituted for it because they sold at lower prices. In 1914 synthetic sulphate of ammonia also began to be produced in important quantities, causing a decline in the price of sulphate in Germany, and thereby affecting the price of nitrate of soda. During the years 1913 and 1914 the price of sugar was also low, which tended to cause some curtailment of sugar-beet production in Europe and a reduced consumption of fertilizer materials. As a result of these various factors, consumption of nitrate in Germany fell off more than 85,000 tons in 1913, and in all of Europe, including Egypt, it declined nearly 125,000 tons, while the consumption of sulphate of ammonia and air nitrates increased. In the United States, on the other hand, consumption of nitrate increased in 1913 more than 160,000 tons, owing to the higher prices received for cotton, but, as shown by the above table and diagram, in spite of this increased demand the price of nitrate followed the declining prices in Europe.

The foregoing is a description of the important factors affecting the price of nitrate of soda in the European market. The price alongside vessel on the coast of Chile is determined mainly by the price in the European market and the prevailing ocean freights. The spot price in Chile is influenced especially by the European price for future deliveries, because of the time it takes for cargoes to reach the European market. Table 35 and Diagram 1 show that the major fluctuations of the alongside price in Chile correspond with those in the consuming markets, while the minor fluctuations are largely independent. During the period when charter rates were fairly stable, the margin between the price alongside and the prices in the European market remained fairly constant, ranging from 20 to 30 cents per 100 pounds, but in 1912 and the first part of 1913, as ocean freights rose, the margin grew wider, so that in March, 1913, it ranged from 60 to 70 cents. In order that the relation of the Chilean to the European price may be more clearly seen, there is presented in the second part of the diagram, above the curves of the Chilean prices alongside vessel, the Chilean prices plus charter rates to Europe for sailing vessels, and the Hamburg prices.

Prices of nitrate in the United States also follow the European prices, as Diagram 1 indicates. This is particularly demonstrated by the fact that in 1912 New York prices rose with the prices in Europe, finally getting above those of Liverpool, yet the consumption of nitrate in the United States in this year fell off sharply, owing to the restricted use of fertilizers, caused by the low price of cotton in 1911 and the fact that the low price of cotton-seed meal apparently led to the substitution of this material for nitrate on a considerable scale. The explanation of this rise in price is that if the exporters of nitrate from Chile to the United States had not received as high prices as were being obtained in Europe, they would have diverted their cargoes to the latter markets. This practice of diverting cargoes to the most advantageous market tends to equalize prices in all the principal markets. Another factor is the potential competition of buyers in the home market. If the price of nitrate of soda in New York were to get sufficiently above the price in Europe or in Chile to make it worth while, some of the large purchasers here who keep in close touch with market conditions would undoubtedly buy some cargoes afloat and divert them to this market. This was done by The American Agricultural Chemical Co. and the Armour Fertilizer Works especially in the first half of 1913.

Beginning in the latter part of August, 1913, the New York prices dropped below those of Liverpool and approached more closely than usual the prices of the continental markets. This depression in price was doubtless due to the advent of the house of Antony, Gibbs & Co. into the American market in competition with the two principal importers. (See p. 31.) In order to gain an entrance this new concern engaged in a price-cutting campaign. During the fall of 1913 nitrate was offered at a price as low as $2.07½ per 100 pounds.

Influence of importers upon domestic prices.—The foregoing discussion indicates that although W. R. Grace & Co. and Wessel, Duval & Co. import the bulk of the nitrate used for fertilizer they are not able to control the price. Almost every year some of the other exporters from Chile attempt to establish themselves in the American field and there is always the possibility that particular cargoes intended for Europe may be diverted to the United States at any time if the market looks more attractive. There is also the possibility that the large American purchasers who follow the market closely may import cargoes for their own use and for sale to others if the difference in price makes it worth while.

The great bulk of the nitrate business of these two importers is done on the future basis. Their purchases frequently call for deliveries over a year or longer, and their sales often cover corresponding periods. As a result their profits depend upon their success in forecasting market conditions. Some cargoes yield a profit while others show a loss. In a rising market their profits are usually larger than when prices are declining.

Section 3. Sulphate of ammonia.

In the study of the price fluctuations of sulphate of ammonia prices have been tabulated for domestic and foreign sulphate sold in the United States and for foreign sulphate sold in the principal

European markets. Tables 36 and 37 show these price data for the period beginning January 1, 1907, and ending June 30, 1914, and Diagram 2, opposite page 134, shows these data in graphic form.

Prices in the European markets were taken from quotations published in various trade journals, such as l'Engrais (Paris), Der Saaten, Dünger und Futtermarkt (Hamburg), and the Iron and Coal Trades Review (London). They are for prompt delivery. The curves for these prices are presented in the first part of the diagram.

Prices of domestic sulphate were obtained from all the principal by-product coke-oven producers in operation in 1913. These prices are average monthly prices f. o. b. plant, including commission, and were computed by dividing the receipts for each month by the quantity shipped, the deliveries being mostly on contracts covering several months. The figures obtained from these by-product coke-oven companies are presented in Table 37 by groups according to the geographical location of the companies. The Illinois-Indiana group includes the two plants of the Illinois Steel Co., located at Joliet, Ill., and Gary, Ind., and the plant of the By-Products Coke Corporation, located at Chicago, Ill. The New York-Pennsylvania group includes the plants of the Lackawanna Steel Co., at Buffalo, N. Y., and Lebanon, Pa.; the plant of the Cambria Steel Co., located at Johnstown, Pa.; the Farrell plant of the Carnegie Steel Co., located at Farrell, Pa., and the plant of the Semet-Solvay Co., located at Steelton, Pa. The Atlantic seacoast group includes the plant of the New England Coke & Gas Co., located at Everett, Mass., near Boston; the plant of the Consolidated Gas Co., located at Astoria, near New York City; and the plant of the Maryland Steel Co., located at Sparrows Point, Md., near Baltimore. The Alabama group includes the plant of the Tennessee Coal, Iron & Railroad Co., located at Corey, Ala.; the plant of the Woodward Iron Co., located at Woodward, Ala., and the plant of the Semet-Solvay Co., located at Ensley, Ala. In the fifth column of Table 37 the prices of all the by-product coke-oven plants have been combined to give an average price f. o. b. plant for the United States. The graphic presentation of these domestic prices is shown in the second part of the diagram. For comparative purposes the combined curve is also repeated in the third part.

Brokers' prices of domestic sulphate f. o. b. Atlantic ports are also given in Table 37. These prices are monthly averages of sales for prompt delivery, and are, therefore, more representative of the market than the prices obtained from producers, which include future deliveries. For comparative purposes the curve for these brokers' prices is given in the third part of Diagram 2.

Prices of foreign sulphate in the United States are shown by monthly averages of the cablegram advices received by the American

Coal Products Co. and various brokers and importers, which prices represent the current market quotations in Liverpool plus the freight and insurance to United States ports, and also by true average monthly prices c. i. f. Atlantic and Gulf ports computed from actual sales of foreign sulphate in this country. The latter prices were obtained from brokers and importers making such sales, and are for prompt delivery. As the table shows they follow closely the cablegram quotations. The curve for the actual sales of foreign sulphate in the United States is presented in the first and third parts of the diagram. The cablegram quotations are not shown graphically.

TABLE 36.—AVERAGE MONTHLY SPOT PRICES PER 100 POUNDS OF FOREIGN SULPHATE OF AMMONIA IN THE PRINCIPAL WORLD MARKETS. 1907–1914.

Month.	Lille, France.	Antwerp, Belgium.	Hamburg, Germany.[1]	Liverpool, England.[1]	C. i. f. Atlantic and Gulf ports.	Cable advices c. i. f. Atlantic and Gulf ports.
1907—January	$2.66	$2.56	$2.68	$2.59	$3.00	$3.00
February	2.69	2.67	2.73	2.62	3.04	3.04
March	2.67	2.69	2.74	2.58	2.99	3.02
April	2.67	2.65	2.70	2.56	3.06	3.02
May	2.65	2.58	2.64	2.57	3.00	3.00
June	2.67	2.56	2.69	2.60	3.07	3.02
July	2.67	2.54	2.68	2.58	2.98	3.01
August	2.65	2.53	2.69	2.58	3.01	3.01
September	2.65	2.55	2.70	2.57	3.02	3.03
October	2.66	2.56	2.68	2.60	[2] 3.01	3.01
November	2.64	2.56	2.68	2.63	[2] 3.05	3.05
December	2.63	2.63	2.68	2.61	3.06	2.99
1908—January	2.66	2.66	2.72	2.58	3.12	3.04
February	2.68	2.68	2.72	2.60	3.04	3.04
March	2.68	2.68	2.73	2.62	3.05	3.08
April	2.71	2.74	2.79	2.69	3.05	3.15
May	2.71	2.70	2.79	2.70	3.01	3.14
June	2.71	2.63	2.75	2.64	2.96	2.98
July	2.70	2.57	2.63	2.46	2.91	2.90
August	2.66	2.54	2.62	2.45	3.05	2.95
September	2.65	2.54	2.68	2.47	2.97	2.92
October	2.65	2.53	2.64	2.47	2.89	2.91
November	2.63	2.52	2.58	2.46	2.90	2.89
December	2.61	2.44	2.59	2.39	2.87	2.86
1909—January	2.60	2.49	2.62	2.51	2.84	2.96
February	2.56	2.53	2.65	2.50	2.91	2.92
March	2.60	2.56	2.66	2.50	2.93	2.97
April	2.61	2.59	2.68	2.52	2.87	2.95
May	2.53	2.53	2.59	2.43	2.84	2.87
June	2.51	2.52	2.55	2.41	2.83	2.87
July	2.52	2.49	2.55	2.41	2.75	2.89
August	2.53	2.43	2.55	2.43	2.59	2.67
September	2.54	2.46	2.57	2.45	2.60	2.62
October	2.54	2.45	2.57	2.45	2.58	2.58
November	2.53	2.46	2.53	2.42	2.58	2.56
December	2.54	2.46	2.53	2.45	2.59	2.63
1910—January	2.54	2.43	2.58	2.52	2.66	2.67
February	2.57	2.46	2.61	2.56	2.72	2.72
March	2.66	2.49	2.77	2.67	2.81	2.81
April	2.73	2.51	2.76	2.65	2.56	2.80
May	2.68	2.52	2.61	2.59	2.68	2.72
June	2.61	....	2.63	2.56	2.60	2.74
July	2.62	....	2.63	2.55	2.68	2.74
August	2.65	....	2.65	2.61	2.74	2.80
September	2.68	....	2.74	2.69	2.83	2.87
October	2.70	....	2.82	2.78	2.83	2.95
November	2.71	....	2.86	2.82	2.91	3.00
December	2.72	....	2.84	2.76	2.84	2.91
1911—January	2.80	....	2.86	2.86	2.97	3.03
February	2.85	2.87	2.97	2.98	2.95	3.15
March	3.00	2.91	3.13	3.11	3.03	3.24
April	3.03	2.89	3.10	2.98	3.04	3.14

[1] Liverpool prices are for 24 per cent sulphate f. o. b. in bags less 2½ per cent for cash. Hamburg prices in 1913 and 1914 are for 24½ per cent sulphate. With these exceptions, prices are for the standard grade, containing 25 per cent of ammonia.

[2] Interpolated from cable advices.

TABLE 36.—AVERAGE MONTHLY SPOT PRICES PER 100 POUNDS OF FOREIGN SULPHATE OF AMMONIA IN THE PRINCIPAL WORLD MARKETS, 1907–1914—Continued.

Month.	Lille, France.	Antwerp, Belgium.	Hamburg, Germany.	Liverpool, England.	C. i. f. Atlantic and Gulf ports.	Cable advices c. i. f. Atlantic and Gulf ports.
1911—May	$2.88	$2.84	$3.00	$2.90	$2.99	$3.03
June	2.91	2.82	2.99	2.81	2.95	2.99
July	2.94	2.86	3.00	2.92	3.07	3.12
August	2.95	2.87	3.09	3.03	3.10	3.19
September	3.04	2.92	3.16	3.03	3.13	3.17
October	3.08	2.94	3.17	3.05	3.18	3.23
November	3.09	2.95	3.17	3.07	3.20	3.23
December	3.09	2.95	3.19	3.08	3.19	3.25
1912—January	3.11	3.00	3.19	3.10	3.20	3.29
February	3.16	3.10	3.24	3.14	3.19	3.30
March	3.18	3.19	3.33	3.16	3.26	3.34
April	3.10	3.18	3.24	3.27	3.27	3.43
May	3.08	3.05	3.24	3.24	[1] 3.29	3.42
June	3.09	3.20	3.23	3.19	3.25	3.36
July	3.06	3.11	3.17	3.10	3.24	3.26
August	3.09	3.02	3.17	3.11	3.25	3.29
September	3.15	3.02	3.18	3.14	3.29	3.32
October	3.15	3.02	3.20	3.05	3.13	3.24
November	3.14	3.09	3.17	3.01	3.16	3.21
December	3.12	3.05	3.14	3.05	3.23	3.25
1913—January	3.17	3.11	3.18	3.13	3.28	3.32
February	3.19	3.13	3.23	3.10	3.34	3.26
March	3.16	3.13	3.14	3.06	3.24	3.22
April	3.04	3.13	3.03	3.03	3.08	3.18
May	2.89	2.95	3.01	2.90	2.99	3.05
June	2.89	2.95	2.99	2.83	2.95	2.98
July	2.86	2.95	2.96	2.81	2.92	2.99
August	2.85	2.95	2.98	2.83	3.07	3.01
September	2.86	2.92	3.04	2.93	3.11	3.08
October	2.90	2.82	3.09	2.92	3.05	3.03
November	2.87	2.82	3.05	2.84	3.04	3.00
December	2.82	2.77	2.89	2.84	2.90	2.98
1914—January	2.77	2.73	2.85	2.76	2.89	2.87
February	2.74	2.76	2.86	2.73	2.91	2.89
March	2.74	2.76	2.86	2.72	2.94	2.87
April	2.68	2.76	2.85	2.67	2.99	2.84
May	2.63	2.69	2.82	2.53	2.70	2.64
June	2.50	2.54	2.77	2.34	2.43	2.50
July	2.47	2.50	2.76	2.37	2.63	....

[1] Interpolated from cable advices.

TABLE 37.—AVERAGE MONTHLY PRICES PER 100 POUNDS OF DOMESTIC SULPHATE OF AMMONIA FOR PRODUCERS AND BROKERS, 1907–1914.

Month.	Producers, f. o. b. plant, all sales.					Brokers prompt sales, f. o. b. Atlantic ports.
	Alabama.	New York and Pennsylvania.	Illinois and Indiana.	Atlantic coast.	All districts combined.	
1907—January	$2.87	$2.93	$2.99	$2.96	$2.94	....
February	2.89	2.92	2.99	2.98	2.95	....
March	2.89	2.91	2.97	2.97	2.93	....
April	2.90	2.90	2.98	2.97	2.94	....
May	2.97	2.94	3.00	2.97	2.97	....
June	3.00	2.97	3.05	2.95	2.98	....
July	2.94	2.95	3.07	2.93	2.95	....
August	3.01	2.94	3.07	2.96	2.97	....
September	2.99	2.94	3.05	2.96	2.97	....
October	2.98	2.95	3.04	2.98	2.97	....
November	2.98	2.95	3.03	2.98	2.97	....
December	3.01	2.95	3.04	2.98	2.99	....
1908—January	2.97	2.96	3.04	2.99	2.98	....
February	2.99	2.94	3.04	2.98	2.99	....
March	2.98	2.94	3.04	2.97	2.98	....
April	2.93	2.93	....	2.96	2.94	....

TABLE 37.—AVERAGE MONTHLY PRICES PER 100 POUNDS OF DOMESTIC SULPHATE OF AMMONIA FOR PRODUCERS AND BROKERS, 1907–1914—Continued.

Month.	Producers, f. o. b. plant, all sales.					Brokers prompt sales, f. o. b. Atlantic ports.
	Alabama.	New York and Pennsylvania.	Illinois and Indiana.	Atlantic coast.	All districts combined.	
1908—May	$2.93	$2.93	....	$2.96	$2.95	....
June	2.97	2.93	....	2.95	2.95	....
July	2.97	2.92	$3.04	2.96	2.97	....
August	2.97	2.88	3.02	2.94	2.95	....
September	2.99	2.87	3.02	2.95	2.93	....
October	2.98	2.90	3.07	2.95	2.94	....
November	2.97	2.90	....	2.95	2.94	....
December	2.97	2.84	3.05	2.92	2.92	....
1909—January	2.97	2.81	3.06	2.93	2.93	$2.93
February	2.97	2.85	2.89	2.95	2.92	2.91
March	2.97	2.85	2.90	2.92	2.91	3.01
April	2.97	2.85	2.98	2.94	2.92	2.95
May	2.95	2.86	2.90	2.93	2.91	3.00
June	2.93	2.83	2.90	2.90	2.90	3.00
July	2.94	2.81	2.78	2.90	2.85	....
August	2.88	2.58	2.62	2.79	2.74	2.60
September	2.70	2.52	2.65	2.69	2.64	2.63
October	2.69	2.48	2.70	2.71	2.64	2.64
November	2.75	2.48	2.65	2.65	2.59	2.75
December	2.78	2.49	2.50	2.75	2.60	2.58
1910—January	2.66	2.48	2.53	2.60	2.56	2.78
February	2.57	2.47	2.62	2.62	2.58	2.80
March	2.56	2.48	2.58	2.67	2.57	2.95
April	2.64	2.51	2.52	2.65	2.57	2.89
May	2.70	2.53	2.52	2.63	2.58	[1]2.93
June	2.73	2.66	2.54	2.65	2.66	2.83
July	2.73	2.67	2.63	2.64	2.66	....
August	2.73	2.67	2.47	2.65	2.63	2.85
September	2.73	2.71	2.68	2.67	2.69	2.82
October	2.72	2.69	2.67	2.70	2.70	2.97
November	2.72	2.68	2.72	2.74	2.71	2.99
December	2.73	2.69	2.71	2.72	2.71	3.00
1911—January	2.71	2.68	2.71	2.71	2.70	3.05
February	2.72	2.69	2.71	2.72	2.71	2.98
March	2.72	2.72	2.90	2.80	2.79	3.13
April	2.72	2.67	2.80	2.84	2.75	[1]2.97
May	2.92	2.84	2.88	2.83	2.87	....
June	2.96	2.94	2.89	2.82	2.88	2.95
July	2.97	2.95	2.94	2.87	2.92	3.05
August	2.95	2.99	2.89	2.79	2.92	3.15
September	2.94	2.99	2.93	2.74	2.91	3.18
October	2.96	2.99	2.80	2.87	2.91	3.28
November	2.94	2.98	2.96	2.87	2.93	3.23
December	2.95	3.00	2.89	2.87	2.93	....
1912—January	2.97	3.00	2.85	2.97	2.92	3.23
February	2.95	3.03	2.93	2.94	2.96	3.23
March	2.97	3.01	2.93	3.07	2.99	3.30
April	3.00	3.00	2.99	2.93	2.98	[1]3.29
May	2.99	3.00	2.93	2.96	2.96	3.26
June	3.07	3.07	2.94	2.98	3.02	3.28
July	3.03	3.07	2.98	3.00	3.02	3.25
August	3.05	3.06	2.93	2.99	3.00	3.25
September	3.06	3.05	3.01	2.95	3.03	3.31
October	3.07	3.06	3.09	3.01	3.06	3.18
November	3.00	3.05	2.93	3.07	2.99	[1]3.25
December	3.01	3.05	2.96	3.04	3.00	3.24
1913—January	3.01	3.04	2.98	3.13	3.02	3.30
February	3.01	3.06	2.93	3.12	3.00	3.31
March	3.01	3.11	2.93	3.16	3.02	3.30
April	3.00	3.07	2.92	3.14	3.02	3.29
May	2.96	3.06	2.96	3.09	3.01	3.22
June	2.97	3.00	2.99	3.11	3.00	3.00
July	2.99	2.98	2.94	3.07	2.99	2.98
August	2.95	2.98	2.83	3.07	2.94	3.95
September	2.98	2.98	2.95	3.05	2.99	3.03
October	2.97	2.97	2.79	3.10	2.92	3.11
November	2.97	2.98	2.82	3.12	2.94	3.19
December	2.98	2.97	2.86	3.10	2.94	3.06
1914—January	2.96	2.93	2.76	3.09	2.87	2.88
February	2.94	2.96	2.72	3.11	2.87	3.14
March	2.94	2.94	2.76	3.09	2.89	3.12
April	2.98	2.94	2.71	3.07	2.89	2.90
May	2.91	2.98	2.75	3.04	2.88	....
June	2.68	2.99	2.72	3.00	2.81	....

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[1] Prompt purchases by fertilizer manufacturers.

Price fluctuations.—The price statistics and diagram for sulphate of ammonia show three major price movements since January, 1907, in all the principal markets. From May and June, 1908, until the close of 1909 there was a downward trend. In the European markets the decline was gradual, but in the United States as soon as the removal of the duty of 30 cents per 100 pounds by the tariff law of 1909 was assured the drop was sudden. In the latter part of 1909 and the first part of 1910 prices began to rise rapidly and, except for two small reactions in 1910 and one severe reaction in 1911, continued to rise until the culmination of the upward movement in March and April, 1912. During the rest of the year 1912 prices remained at a high level, with a gradual downward trend in Europe. In the United States prompt prices rose to a higher level in January, 1913, than had been reached in the spring of 1912. Beginning in the spring of 1913 prices in all the principal markets declined rapidly until in June, 1914, they reached $2.34 per 100 pounds in the Liverpool market, which represented a decline of about 90 cents per 100 pounds from the high prices of the spring of 1912.

Diagram 2 shows that the prices of sulphate of ammonia in the United States had the same trend as the prices in the English market. The prices of domestic sulphate sold through brokers f. o. b. Atlantic seaports for prompt delivery follow the prices of foreign sulphate fairly closely, while the prices of producers f. o. b. plant, although showing the same general trend, are lower and do not fluctuate so widely, especially since January, 1910. This is due to the fact that as the output of sulphate has increased, long-term contracts, which give stability to prices, have become more numerous. In a rising market, such as occurred during the years 1910 to 1912, they result in a lower return than would be obtained for prompt sales. Another factor keeping the producers' prices below the c. i. f. Atlantic coast prices for prompt sales is the charge for transportation from the coke-oven plants to the fertilizer manufacturers, especially those located on the seaboard. When delivered to interior points the charge for transportation is less a factor in holding down the price of the domestic product, since the foreign sulphate also has to pay a freight rate to reach the same interior points.

Causes of major price fluctuations.—As shown by the fourth part of Diagram 2, the major movements in the price of sulphate of ammonia are similar to those of nitrate of soda, which suggests that the price movements of both materials are controlled by somewhat similar causes. The major fluctuations of sulphate usually precede those of nitrate, and the minor fluctuations are more rapid.

Several factors combine to make sulphate of ammonia more quickly responsive to changes in demand than nitrate of soda. The present world production in tons of the former is considerably less than half

of the latter, which in 1913 amounted to more than 3,000,000 net tons, so that when the normal demand is satisfied there is less surplus sulphate to be disposed of. A much larger percentage of the total production of sulphate is used for fertilizer than of nitrate. At least 25 per cent of the total annual output of nitrate of soda goes into the industries where the demand is more constant than in agriculture, while probably not more than 10 per cent of the sulphate of ammonia produced is used in the industries, this demand for ammonia being supplied largely in the form of ammoniacal liquor.

The production of sulphate of ammonia is not so responsive to the fluctuations of prices as is the production of nitrate of soda, since sulphate is a by-product of industries unrelated to agriculture or the needs for fertilizer. The total output each year depends to a considerable extent upon the conditions in the coke and gas and the iron and steel industries in various countries. Nevertheless, rising prices of sulphate doubtless tend to stimulate somewhat the change from beehive to by-product coke ovens, especially where the former are still extensively used, as in the United States, and also may increase somewhat the proportion of ammonia recovered in the form of sulphate.

The price of foreign sulphate of ammonia is fixed in the European market, where the demands of various consuming countries are focused upon the supply available for fertilizer purposes. The prices of domestic sulphate in the United States are fixed with reference to the prices of English sulphate, which is imported in considerable quantities. The English market for sulphate, as already noted (see p. 47), is an open one. The producers dispose of their output through brokers who are active competitors. At Manchester there is an exchange where sulphate is bought and sold in much the same manner as produce on the produce exchanges. In the determination of English prices the conditions in the principal importing markets, such as the United States, Japan, Java, etc., have an important influence, in that they measure the demand for the surplus stocks. The quantity required by the United States depends upon the demand for mixed fertilizers, which is affected especially by conditions in the cotton States, and upon the quantity of domestic sulphate produced, which is affected by conditions in the steel trade.

The important factors affecting the price of sulphate can best be explained by an examination of the three major movements referred to above.

The first of these three major movements, which was downward, began in the spring of 1908 and continued until the latter part of 1909. One of the dominant factors in this decline was the easing off of demand in Japan. The use of high-class fertilizers at that time was comparatively new in Japan, and the importers seem to have miscalculated in making their purchases in 1907 and the early part of 1908 and apparently bought more sulphate of ammonia than the country was prepared to consume.[1] In the first quarter of 1909 the imports were only 2,599 tons as against 22,568 for the same period in 1908. At about the same time that exports of sulphate of ammonia to Japan were falling off, a considerable shrinkage began to occur in the demand from the Continent, the United States, and the Pacific islands. Shipments to the Continent fell off especially during the last six month of 1909, owing to a number of factors, such as the slackening demand, the competition of German sulphate, which also entered the market in Java during the year, and the rapid decline in the price of nitrate of soda which began in May and did not materially slacken throughout the year.[2]

In November, 1909, the initial stage of an upward movement which was to continue until the spring of. 1912 set in. This rise in the price of sulphate in the English market was due in part to the increased demand for English sulphate in the United States and Japan. The United States, for instance, imported from the United Kingdom 81,000 tons in 1910 and 86,000 tons in 1911 as compared with 40,000 in 1909. (See p. 45.) The high prices of cotton in the United States in 1910 and 1911 resulting from the small crop of 1909 led to increased use of mixed fertilizers. As is shown in Chapter VIII, the season of 1910 was the most prosperous one the fertilizer manufacturers had experienced in a decade. (See p. 228.) The Japanese imports went steadily upward from 49,000 tons in 1909 and 57,000 tons in 1910 to 76,000 tons in 1911. The German, French, and Belgian imports shrank from 49,000 tons in 1909 to 10,000 tons in 1911, but the steady imports by Spain and Portugal, Italy, and the Canaries brought the total for Europe slightly above that for the preceding year.[3]

The sharp advance in the European market which began in December, 1910, and continued through the early part of 1911, was due to a shortage in the supply for prompt delivery, caused by the heavy exports from the United Kingdom to the United States and Japan.

In England labor troubles in December, 1911, caused a decrease in the output of sulphate of ammonia; and in March and April, 1912, a widespread colliers' strike brought about a big shrinkage in the production, as coke ovens and gas works were unable to consume their normal quantities of coal for two months after the strike was settled.[4] Prices of sulphate, therefore, which had been steadily rising since June, 1911, were forced to a very high level, and culminated in April, 1912, in the highest price that had been reached in 20 years.

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[1] Bradbury & Hirsch, Review of the Market for Sulphate of Ammonia, 1908.

[2] Bradbury & Hirsch, op. cit., 1909.

[3] Bradbury & Hirsch, op. cit., 1911.

[4] Bradbury & Hirsch, op. cit., 1912.

The decline in the price of foreign sulphate which began in the spring of 1912 appears to have been due to the increase of stocks in the European market caused especially by the falling off in the consumption of foreign sulphate in the United States. The output of sulphate in 1912 greatly increased in all of the producing countries, especially in Germany and the United States. But the favorable conditions in the beet-sugar industry on the Continent resulted in greatly increased consumption in 1912, so that the exports from Germany were no larger than usual. In the United States, however, there was a marked falling off in consumption of foreign sulphate, owing not only to a large increase in domestic output, resulting from the boom in the steel business and the installation of by-product ovens, but also to the poor demand for fertilizers and the increased use of cottonseed meal as an ammoniate following the bumper cotton crop in 1911, which led to low prices of cotton and cottonseed meal. The imports of foreign sulphate from the United Kingdom were about 51,000 tons in 1912, as compared with 86,000 tons in 1911. The year 1912 was the poorest one the fertilizer manufacturers had experienced in a decade.

The sharp decline in the prices of sulphate, which began in the early part of 1913 and continued into 1914, was due largely to conditions in the European market. The consumption of sulphate was not increasing as rapidly as production, while atmospheric nitrogen products were becoming important competitors. The price of nitrate of soda was also declining as a result of overproduction of this material and the accumulation of large stocks in the European markets (see p. 127), so that by May, 1913, it was cheaper per unit of nitrogen in the Hamburg market than sulphate of ammonia, thus causing a substitution of it for the latter. Before the close of the year 1913, also, synthetic sulphate of ammonia began to enter the market in Germany in competition with the by-product sulphate and during the first half of 1914 this competition become so severe that the prices in all the European markets became unsettled. In 1913 exports of sulphate of ammonia from Russia materially reduced the shipments from the United Kingdom to Italy and Spain.[1] Conditions affecting the demand for fertilizers in the United States improved in 1913, but the rapidly increasing production of domestic sulphate prevented the importation of foreign sulphate on a large enough scale to absorb the surplus in the European market. Japan was also unable to absorb this surplus, since the consumption of sulphate fell off sharply in 1914, due partly to the substitution of soya-bean cake, which was disposed of in this way on account of the slackening demand for soya beans in Europe.[2]

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[1] Bradbury & Hirsch, op. cit., 1913.

[2] Bradbury & Hirsch, op. cit., 1914.

Influence of the American Coal Products Co. upon prices.—The preceding discussion shows that, although the American Coal Products Co. during the period 1907 to 1913 controlled from 70 per cent to 90 per cent of the sales of domestic sulphate and from 28 per cent to 56 per cent of the total sales of sulphate in the United States (see p. 50), apparently it has not obtained monopoly prices for such sales. The company claims to fix its prices with reference to the prices of foreign sulphate, and this claim appears to be substantiated by the facts. The prices given in Table 37 and the accompanying diagram indicate that the by-product coke-oven producers selling through the American Coal Products Co. did not receive as high prices during the period of rising prices as were obtained by brokers in the spot market. Information obtained by the Commission also shows that those companies selling their output directly or through brokers have been able, especially in recent years, to obtain better prices than other concerns as advantageously situated who are under contract to sell through the American Coal Products Co.

The prices received by producers selling through the American Coal Products Co. include commissions which range from 2½ per cent to 10 per cent in comparison with the 1 per cent commission of fertilizer brokers included in the spot prices. These producers, however, appear on the whole to be satisfied with this arrangement. There are doubtless certain compensating advantages both for the large commissions paid and the lower prices received. The expense of maintaining a selling organization is not incurred, and the other by-products, such as ammonia liquor, tar, etc., are all disposed of to or through the same agency. The producers in this country do not contribute to the cost of maintaining a sulphate propaganda as do the producers in the United Kingdom, this expense being borne by the American Coal Products Co. For the sums paid out for this purpose see Chapter II, p. 54.

Section 4. Cottonseed Meal.

Cottonseed meal prices were obtained from producers, jobbers, and brokers covering the period from January 1, 1907, to June 30, 1914. These quotations were for prime meal containing from 7½ to 8 per cent of ammonia sold f. o. b. mill for delivery within a month from the date of contract. In tabulating these prices average monthly prices f. o. b. mill have been computed for six States separately, as well as for all of these States combined. Sales under 10 tons have been omitted as not being representative of the wholesale market. Prices for Texas were found to run somewhat above those for the States given, doubtless on account of the higher protein content of the meal produced, and therefore have not been included in the table.

Prices for Louisiana have also been omitted, since the sales were found to be mainly in small quantities and the prices to be affected largely by local conditions. These average monthly prices are presented in Table 38 and shown graphically in Diagram 3, facing page 140.

TABLE 38.—AVERAGE MONTHLY PRICES PER NET TON OF PRIME COTTONSEED MEAL, FOR PROMPT TRANSACTIONS, F. O. B. MILL, BY STATES, 1907–1914.

Month.	Georgia.	Alabama.	Mississippi.	Tennessee.	Oklahoma.	Arkansas.	All States combined.
1907—January	$24.51	$22.71	$24.05	....	....	....	$22.96
February	23.83	23.70	23.03	....	....	....	23.35
March	23.57	23.94	23.09	....	....	....	23.48
April	22.44	22.17	22.99	....	....	....	22.61
May	23.50	21.28	23.36	....	....	....	22.58
June	23.14	21.61	23.09	....	....	....	22.67
July	22.87	....	22.30	....	....	....	22.84
August	23.50	23.25	22.05	....	....	....	22.95
September	23.49	23.07	21.46	....	....	$22.75	23.14
October	23.60	23.50	22.60	$24.04	$23.00	23.35	23.40
November	23.27	22.17	22.38	22.44	23.07	22.20	22.58
December	22.24	22.10	22.24	23.00	23.91	21.90	22.15
1908—January	22.51	23.08	23.16	22.14	22.76	21.63	22.01
February	22.25	22.70	22.93	22.25	22.69	21.74	22.15
March	21.84	22.66	21.98	22.25	23.07	22.20	22.12
April	22.83	22.96	22.29	23.50	22.50	22.43	22.53
May	23.46	23.67	23.51	23.50	22.50	22.69	23.30
June	23.36	23.00	24.31	23.70	....	23.01	23.70
July	25.07	23.65	23.41	23.40	....	23.43	24.11
August	23.37	21.83	23.25	....	....	23.71	22.42
September	22.73	22.69	23.10	23.50	22.75	22.24	22.73
October	23.00	22.15	22.88	23.76	23.00	22.94	23.09
November	22.73	22.25	23.06	23.53	23.20	23.00	22.98
December	22.80	22.72	23.03	23.40	23.54	22.97	23.04
1909—January	22.69	22.45	22.68	23.29	24.50	23.02	22.94
February	22.78	22.46	22.69	23.60	24.00	23.01	22.96
March	23.11	23.16	23.95	24.18	23.09	23.36	23.54
April	24.97	25.22	25.74	26.01	24.26	24.80	25.37
May	26.03	27.61	28.31	27.54	....	26.47	26.92
June	29.85	28.46	28.28	28.50	....	26.38	28.34
July	29.75	26.21	28.32	26.20	....	24.84	26.52
August	27.57	25.75	25.93	25.82	....	27.25	26.16
September	24.65	25.85	26.07	26.73	....	25.82	25.37
October	26.09	26.81	26.37	27.44	27.82	26.96	26.96
November	28.20	26.82	27.23	28.70	28.10	27.54	28.06
December	28.51	28.05	27.08	28.55	28.48	28.25	28.24
1910—January	29.66	28.05	29.10	29.81	29.01	28.64	29.22
February	30.06	29.23	28.81	29.12	28.99	28.76	29.14
March	28.50	28.73	27.79	28.72	28.82	28.51	28.38
April	28.09	29.11	28.07	28.50	28.35	26.04	28.09
May	26.92	26.62	27.18	27.36	28.47	25.47	26.91
June	25.77	26.03	27.57	....	26.90	24.90	25.83
July	25.67	24.25	25.88	25.03	25.70	24.22	24.65
August	24.90	24.83	26.13	25.08	....	25.52	25.20
September	25.44	25.30	25.11	26.15	....	25.25	25.38
October	25.82	26.13	24.47	25.28	25.53	24.20	24.87
November	26.04	25.26	23.56	24.31	24.46	24.47	24.38
December	26.67	25.36	23.41	24.43	24.80	23.19	24.21
1911—January	26.63	25.35	23.40	23.69	24.34	22.73	23.71
February	25.39	25.14	22.71	22.65	22.58	21.23	22.38
March	25.65	24.61	22.77	22.76	21.32	21.29	22.44
April	24.80	24.68	22.70	23.63	21.70	22.26	23.07
May	23.91	24.98	22.66	23.46	23.34	22.28	23.07
June	25.01	24.25	24.32	23.83	23.95	22.45	23.99
July	23.66	24.51	24.52	25.12	25.46	23.85	24.61
August	23.34	23.11	23.04	24.18	24.89	....	23.39
September	23.57	23.90	24.53	24.68	24.41	23.79	23.96
October	23.67	24.60	23.58	24.32	23.48	23.34	23.73
November	23.80	24.34	23.72	24.44	24.27	23.84	24.01
December	22.53	23.91	23.41	24.10	24.88	23.54	23.72
1912—January	22.22	22.67	23.15	23.93	25.33	23.84	23.44
February	23.82	23.39	24.31	24.92	25.77	24.58	24.35
March	24.79	24.20	26.26	25.70	26.10	25.13	25.38
April	24.77	24.89	26.71	25.89	26.96	26.41	25.72
May	23.73	26.31	26.54	26.53	27.26	25.59	25.10
June	24.63	25.54	25.15	23.68	27.12	25.79	24.71
July	24.34	25.34	24.87	24.79	26.88	26.25	25.08
August	24.21	25.25	25.10	25.10	25.72	26.78	25.03
September	23.23	23.43	23.98	24.06	22.74	23.27	23.69

TABLE 38.—AVERAGE MONTHLY PRICES PER NET TON OF PRIME COTTONSEED MEAL, FOR PROMPT TRANSACTIONS, F. O. B. MILLS, BY STATES, 1907–1914—Continued.

Month.	Georgia.	Alabama.	Mississippi.	Tennessee.	Oklahoma.	Arkansas.	All States combined.
1912—October	$23.07	$24.10	$23.42	$24.43	$23.54	$23.28	$23.49
November	23.37	24.24	23.71	24.36	23.53	23.45	23.65
December	24.59	25.96	24.45	25.23	23.81	24.48	24.59
1913—January	25.20	25.68	24.49	25.40	23.76	24.43	24.75
February	25.05	25.17	23.96	24.31	22.91	23.56	23.94
March	25.51	24.85	24.27	24.45	22.94	23.55	24.06
April	26.29	25.45	25.61	25.63	23.84	25.14	25.10
May	28.78	26.77	27.09	26.24	24.19	25.58	25.64
June	27.66	26.40	27.03	26.00	24.99	25.79	25.88
July	26.40	28.69	29.38	29.79	26.98	27.57	28.61
August	25.47	25.83	28.44	25.50	26.90	26.08	25.91
September	25.10	26.21	26.02	27.17	29.48	26.96	26.25
October	25.40	25.68	25.73	26.77	27.80	26.61	26.39
November	25.77	26.03	25.78	26.66	27.66	26.19	26.34
December	25.33	26.38	25.92	26.94	27.95	26.00	26.41
1914—January	25.61	26.91	25.84	26.45	27.79	26.13	26.25
February	26.89	26.95	24.66	25.60	....	25.12	25.57
March	26.45	26.57	24.95	25.97	....	25.74	25.89
April	26.29	27.05	26.16	26.48	....	26.86	26.57
May	26.08	26.45	25.35	25.02	....	26.20	25.92
June	26.27	27.51	25.62	25.70	....	26.03	26.28

Price fluctuations.—During the years 1907 and 1908 prices of cottonseed meal averaged around $23 per ton. From this low price level four major movements have taken place in all the six States. There was an upward movement beginning in the spring of 1909 and continuing, except for the sharp reaction in July and August, 1909, until the spring of 1910, when average prices in most States went above $28 per ton. From this high level there was a decline, prices reaching the lowest figures during the year 1911, when in most States the average prices got below $24 per ton. Beginning about the first of February, 1912, prices began again to rise, and after a severe reaction in the fall of that year continued rising until the culmination of the movement in July, 1913, when the averages in most States were again above $28 per ton. Since July, 1913, there has been a downward movement, which was accentuated in the fall of 1914 by the restriction of exports on account of the European war. At one time prime cottonseed meal sold below $20 per ton. In 1915, however, there was a substantial recovery. By the end of October the price in the Atlanta market was $30 per ton.

While the prices of cottonseed meal in all the cotton-growing States seem to follow the same general trend, they sometimes vary several dollars a ton in a given month. This appears to be due to local conditions, such as a scarcity of meal for immediate needs, an off-grade crop in a particular State, or a crop of exceptional quality in another. The local scarcity of meal frequently results in a sharp rise in prices during the summer months before a new crushing season begins.

Causes of major price fluctuations.—As has already been noted (see p. 57), it is estimated that about one-third of the total production of cottonseed meal and cake is consumed for fertilizer purposes in the United States and two-thirds for stock food either in this country or in Europe. Hence, conditions in the grain markets have a greater effect upon the price of cottonseed meal than conditions in the fertilizer industry, although this latter factor should not be overlooked. The price of corn, especially, affects the price of cottonseed meal and may be considered the dominant factor in the situation. The relation of corn prices and cottonseed meal prices is shown by the second part of the diagram above. The quantity of cottonseed meal produced, which depends upon the size of the cotton crop, is also an important factor affecting cottonseed meal prices. The size of the cotton crop also affects the price of cotton and thus the demand for fertilizer. The price of cottonseed meal may, therefore, be said to be largely determined by the size of the corn and cotton crops and the prices of these products. If both crops are large, prices will tend to be low; if both crops are small, prices will tend to be high.

For convenience in discussing the influence of the corn crop and other factors upon the prices of cottonseed meal, there are presented in Table 39 certain statistics regarding the production of corn, cotton, and cottonseed meal and cake for the years 1907 to 1914, inclusive, and the exports of meal and cake by six months' periods for the same years:

TABLE 39.—CORN, COTTON, AND COTTONSEED MEAL AND CAKE PRODUCED AND COTTONSEED MEAL AND CAKE EXPORTED, 1907-1914.

Year.	Corn crop (in 1,000 bushels).	Cotton crop (in 1,000 bales).[1]	Cottonseed meal and cake produced (in 1,000 tons).[1]	Cottonseed meal and cake exported (tons).[1]	
				July-December.	January-June.
1907	2,592,320	11,058	1,043	221,417	243,227
1908	2,668,651	13.086	1,492	365,643	251,233
1909	2,772,376	10,073	1,326	155,984	164,060
1910	2,886,260	11,568	1,792	205,628	196,670
1911	2,531,488	15,553	2,151	319,073	327,773
1912	3.124,746	13,489	1,999	271,304	292,742
1913	2,446,988	13,983	2,220	209.796	190,191
1914	2,672,804	15,906	2,648	309,543	429,990

[1] Cotton and cottonseed meal and cake produced are for growth year; exports are for fiscal year following

The rise in the price of cottonseed meal, which began in the spring of 1909 and culminated in the spring of 1910, was due to a number of factors. In 1907 the corn crop was only 2,592,320,000 bushels, as against 2,927,416,091 in 1906, and in 1908 it was only 2,668,651,000 bushels. In 1907 the price of No. 2 corn had not risen above 66½ cents a bushel, but by September, 1908, the month in which cottonseed meal began to rise in most of the producing States, it had reached 82 cents. Beginning in 1909, the price of corn advanced steadily from 58¼ cents, the lowest price, in January, to 77 cents, the highest price, in June. Through this period the price of cottonseed meal was also advancing rapidly in sympathy. These advances in the first half of 1909 took place in spite of the poor demand for fertilizers, caused by the low prices of cotton following the large cotton crop of 1908, which was 2,000,000 bales greater than the crop of 1907, and in spite of the increase in the production of cottonseed meal in 1908 over 1907 of nearly 450,000 tons. As an offset to the increased production of meal, the exports for the fiscal year 1909 (616,876 tons) were heavier than they had been since 1901, with the exception of 1907, which was the largest on record, and more than 152,000 tons greater than those of 1908. Through the months of September, October, November, and December, 1908, when practically no cottonseed meal except that of the 1908 production was available, foreign countries made comparatively heavy demands upon the American supply, the shipments being 346,913 tons, as against 187,923 during the same months in 1907.

The temporary downward reaction in cottonseed-meal prices during the summer of 1909 followed the break in corn prices, which fell from 77 cents in June to 59 cents in October.

The small cotton crop of 1909 appears to have been the dominant factor in the rapid rise in the price of cottonseed meal during the latter part of 1909 and the first part of 1910. The production was more than 3,000,000 bales below that of 1908, and the output of cottonseed meal was 166,000 tons less than it was in the preceding year. The high prices of cotton, which resulted from the small crop of 1909, of course stimulated planting and increased the consumption of cottonseed meal for fertilizer in the Southern States in the spring of 1910. The corn crop of 1909 was larger than that of the preceding year, but it was not a bumper crop, so that prices in the fall of 1909 and spring of 1910 remained fairly high until the outcome of the following year's crop was known.

The downward movement in the price of cottonseed meal which continued throughout the years 1910 and 1911 was due primarily to the decline in the price of corn, caused by the bumper crop of 1910, which reached 2,886,260,000 bushels, as compared with 2,772,376,000 bushels in 1909. Prices for futures in corn began to break as early as June, while spot prices did not begin to break until September, when they dropped from 60 cents, the highest in that month, to 45½ cents, the lowest, in March, 1911. The prices of cottonseed meal followed the same course, getting below $21.50 a ton in Oklahoma and Arkansas in March, 1911.

The other factors affecting the prices of cottonseed meal during this period were favorable to a rise in price rather than to a decline. The two small cotton crops of 1909 and 1910 had resulted in high cotton prices and an increase in the demand for fertilizer, as well as in a smaller production of cottonseed meal. Thus during the fall of 1910 and spring of 1911, while cottonseed-meal prices were declining, those of the other organic ammoniates and also sulphate of ammonia, which fluctuate more directly in response to the demand for fertilizer, were rising rapidly.

In April, 1911, spot prices of corn began to rise, going from 45.5 cents per bushel low in March, 1911, to 82.5 cents high in May, 1912, owing to the small corn crop of 1911. This rise was partially followed by cottonseed-meal prices, particularly in the States where meal is consumed most largely for stock food. Counteracting influences appear to have restrained this rise, however. The bumper cotton crop of 1911 (15,553,073 bales) had resulted in low cotton prices and a falling off in the demand for fertilizers for the following year. The production of cottonseed meal in the season of 1911 was also considerably in excess of former years, being 2,151,000 tons, as compared with 1,792,000 tons in 1910. The increased exports during the last three months of 1911 and the first three months of 1912 partially offset this large production. These exports for the six months' period amounted to about 541,000 tons, against 270,000 tons for the same period in the preceding year.

Beginning in May, 1912, corn prices began to decline, and continued downward until January, 1913, owing to the bumper crop of 1912. Meal prices also declined during this period, reaching the lowest prices in October.

From the low prices of October, 1912, cottonseed-meal prices showed a slight recovery until the spring of 1913. The cotton crop of 1912 was 2,000,000 bales less than that of the preceding year, causing better prices for cotton and a better demand for fertilizer as well as a somewhat smaller supply of cottonseed meal (see p. 58). Beginning in February, 1913, corn prices began to rise, reaching 78¼ cents in September. This rise was accelerated during the summer by the certainty of a small corn crop, which turned out to be one of the smallest in years. During the spring and summer of 1913 cottonseed-meal prices also rose rapidly, reaching the highest prices in July prior to the opening of the new crushing season. The cotton crop of 1912 was only normal and the crop of 1913 was not much larger, thus contributing to the scarcity of meal at this time.

After a reaction from the high prices of the summer of 1913 cottonseed-meal prices continued firm, following the trend of corn prices, until about June 1, 1914, when a downward movement of both corn and meal prices set in, caused by prospects of a bumper corn crop of 1914. Later, the outbreak of the European war curtailed the domestic demand for fertilizer materials, causing a further decline.

Influence of cottonseed combinations upon prices.—As has already been pointed out (see p. 65), the cotton-oil mills in several of the Southern States, especially Mississippi, for several years operated under an agreement to control the price of cotton seed and its products. While they succeeded in effectually controlling the price of seed which they purchased in this territory, they apparently were unable to control the wholesale prices of cottonseed products. The prices given in Table 38 do not show any noticeable increase over the prices in other States where the price-fixing combination was not in operation. Information from other sources also bears out the same conclusion.

Section 5. Tankage, dried blood, and fish scrap.

Average monthly prices of high-grade ground tankage and dried blood for the Chicago and New York markets for the period beginning January 1, 1908, and ending June 30, 1914, are presented in Tables 40 to 42, and are shown graphically in Diagram 4, opposite page 146. There are various other grades of abattoir tankage produced and sold, but the standard high grade has been taken as being most representative of the market. It contains on the average from 9½ to 11 per cent of ammonia and from 15 to 17 per cent of bone phosphate of lime. The standard grade of dried blood, averaging from 16 to 17 per cent of ammonia, has also been taken. Prices are per unit of ammonia and for transactions where deliveries were made within a month from the date of contract. Future deliveries are thus eliminated, since they are not as representative of the market as are prompt transactions. The prices are also for the materials in bulk in carload or larger quantities. If shipped in bags, the purchaser has to furnish the bags or pay the shipper for them.

The Chicago prices were taken from actual sales of five large packers and also from the sales of three leading brokers handling packing-house fertilizer materials. The prices are on an f. o. b. Chicago basis and include commissions of 25 cents per ton. Where, as was often the case (see p. 75), the prices of tankage and dried blood sold by the five large packers were on a c. a. f. destination basis, the f. o. b. prices have been computed by deducting the freight charges per unit of ammonia from Chicago to the points of destination. As the tables show, the prices obtained from brokers correspond very closely with those obtained from producers. Only the latter are shown in the diagram.

The New York prices were obtained from five abattoirs located in that city. Four of these are operated by the large Chicago packers. Sales by brokers of the New York output, although useful for comparative purposes, were not complete enough to admit of presentation in tabular form.

Prices are not given for foreign tankage and dried blood, since the imports are not usually large enough to materially affect the market and the grades are not always comparable with the domestic grades used in this price study.

Fish-scrap quotations were obtained from fertilizer brokers, fish-scrap producers, and fertilizer manufacturers. Only the prices obtained from brokers are presented, since they are the most complete. Table 43 shows average monthly prices for the period beginning January, 1907, and ending June 30, 1914, of dried fish scrap produced by the Chesapeake Bay factories, and the diagram presents these data graphically. These sales have been taken to the exclusion of others, since the grade of scrap produced by these factories and the processes of production are comparable for statistical purposes. This fish scrap contains on the average 11 per cent of ammonia and 16 per cent bone phosphate of lime. The prices include the schooner rate to Baltimore, Norfolk, and other Chesapeake Bay points, and also brokers' commissions. The production and sale of fish scrap are seasonal, and contracts for the season's output are frequently made before the fishing season opens. The prices presented in Table 43 include, therefore, not only prompt transactions, but also sales where deliveries were made during a given season. The absence of transactions during the months of January and February is characteristic of the trade.

TABLE 40.—AVERAGE PRICE, PER UNIT OF AMMONIA, OF HIGH-GRADE GROUND TANKAGE, F. O. B. CHICAGO, BY MONTHS, 1908–1914.

Sales by producers.

Month.	1908	1909	1910	1911	1912	1913	1914
January	$2.19	$2.28	$2.76	$2.93	$2.52	$2.40	$3.12
February	2.06	2.18	2.73	2.92	2.22	2.37	3.20
March	1.90	2.30	2.76	2.82	2.21	2.53	3.23
April	1.95	2.29	2.95	2.63	2.19	2.59	3.07
May	....	2.29	2.59	2.62	2.23	2.51	2.66
June	2.09	2.29	2.47	2.77	2.29	2.38	2.68
July	2.23	2.24	2.57	2.79	2.47	2.30	....
August	2.32	2.37	2.67	2.67	2.58	2.37	....
September	2.26	2.31	2.83	2.76	2.26	2.56	....
October	2.28	2.24	2.91	2.67	2.36	2.88	....
November	2.28	2.60	2.95	2.61	2.36	3.06	....
December	2.26	2.63	2.83	2.50	2.40	3.00	....

Sales through brokers.

Month.	1908	1909	1910	1911	1912	1913	1914
January	$2.19	$2.25	$2.69	$2.95	$2.44	$2.31	$3.06
February	2.09	2.30	2.81	2.91	2.17	2.36	3.14
March	2.11	2.29	2.80	2.81	2.22	2.52	3.21
April	2.07	2.28	3.03	2.52	2.17	2.51	2.89
May	2.15	2.20	2.60	2.58	2.23	2.49	2.95
June	2.11	2.31	2.51	2.70	2.26	2.36	2.60
July	2.21	2.32	2.55	2.90	2.32	2.27	....
August	2.29	2.26	2.70	2.50	2.35	2.34	....
September	2.23	2.30	2.84	2.58	2.25	2.53	....
October	2.20	2.35	2.89	2.64	2.23	2.74	....
November	2.24	2.58	2.95	2.58	2.29	3.02	....
December	2.26	2.63	2.77	2.57	2.34	3.00	....

TABLE 41.—AVERAGE PRICE, PER UNIT OF AMMONIA, OF DRIED BLOOD, F. O. B. CHICAGO. BY MONTHS. 1908–1914.

Sales by producers.

Month.	1908	1909	1910	1911	1912	1913	1914
January	$2.41	$2.46	$2.93	$3.20	$2.92	$2.64	$3.20
February	2.33	2.47	2.93	3.29	2.77	2.61	3.30
March	2.31	2.48	3.02	3.25	2.63	2.72	3.41
April	....	2.47	3.10	2.92	2.54	2.81	3.34
May	....	2.45	2.90	2.82	2.39	2.71	3.10
June	2.37	2.44	2.65	2.91	2.50	2.64	2.86
July	2.58	2.42	2.74	3.04	2.48	2.60	....
August	2.64	2.46	2.89	2.90	2.52	2.64	....
September	2.62	2.45	3.13	3.01	2.54	2.83	....
October	....	2.50	3.18	3.02	2.52	2.99	....
November	2.54	2.76	3.18	2.93	2.54	3.16	....
December	2.46	2.90	3.15	2.95	2.58	3.21	....
Sales through brokers.							
January	$2.43	$2.47	$2.94	$3.20	$2.91	$2.64	$3.18
February	2.37	2.47	2.92	3.28	2.73	2.61	3.29
March	2.32	2.46	3.06	3.21	2.62	2.74	3.39
April	2.29	2.45	3.15	2.96	2.45	2.82	3.39
May	2.30	2.48	2.91	2.81	2.37	2.71	2.86
June	2.38	2.41	2.66	2.86	2.47	2.69	....
July	2.50	2.43	2.66	2.90	2.53	....	....
August	....	2.42	2.82	2.90	2.52	2.63	....
September	2.55	2.48	2.98	3.05	2.55	2.78	....
October	2.51	2.48	3.18	3.02	2.51	3.05	....
November	2.50	2.81	3.16	2.98	2.52	3.19	....
December	2.46	2.89	3.15	2.95	2.57	3.20	....

TABLE 42.—AVERAGE PRICE, PER UNIT OF AMMONIA, OF HIGH-GRADE GROUND TANKAGE AND DRIED BLOOD FOR SALES BY PRODUCERS, F. O. B. NEW YORK, BY MONTHS, 1907–1914.

High-grade tankage.

Month.	1907	1908	1909	1910	1911	1912	1913	1914
January	$2.70	$2.77	$2.68	$3.04	$3.37	$2.96	$2.66	$3.22
February	2.70	2.76	2.63	2.96	3.34	2.97	2.67	3.37
March	2.70	2.76	2.69	3.07	3.33	2.81	2.73	3.44
April	2.86	2.55	2.72	3.04	3.23	2.70	2.81	3.26
May	2.82	2.57	2.71	2.84	3.17	2.63	2.78	3.26
June	2.75	2.37	2.64	2.93	3.03	2.53	2.68	3.07
July	2.75	2.42	2.62	2.76	2.90	2.63	2.70	....
August	2.75	2.50	2.59	2.99	2.85	2.57	2.68	....
September	2.75	2.60	2.58	3.13	2.88	2.54	2.75	....
October	2.75	2.57	2.59	3.25	2.93	2.59	3.11	....
November	2.75	2.62	2.70	3.23	2.97	2.62	3.22	....
December	2.77	2.65	2.97	3.27	2.87	2.65	3.22	....
Dried blood.								
January	....	....	$2.67	....	$3.38	$2.96	$2.71	$3.20
February	....	$2.50	2.73	$2.90	....	3.00	2.73	3.40
March	$2.88	2.50	2.74	3.10	3.34	2.84	2.84	....
April	....	2.50	....	3.21	3.12	2.80	3.00	3.45
May	....	....	....	2.76	3.00	2.74	....	....
June	2.80	2.40	2.63	2.80	3.01	2.70	2.70	3.00
July	....	2.60	2.61	2.86	3.00	2.70	2.65	....
August	2.70	2.57	2.60	2.80	3.10	2.70	2.69	....
September	....	2.82	2.53	3.17	....	2.69	2.81	....
October	....	2.70	2.52	3.25	2.97	2.70	3.23	....
November	....	2.60	2.90	3.40	....	2.70	3.15	....
December	....	2.63	2.68	3.28	2.98	2.70	3.23	....

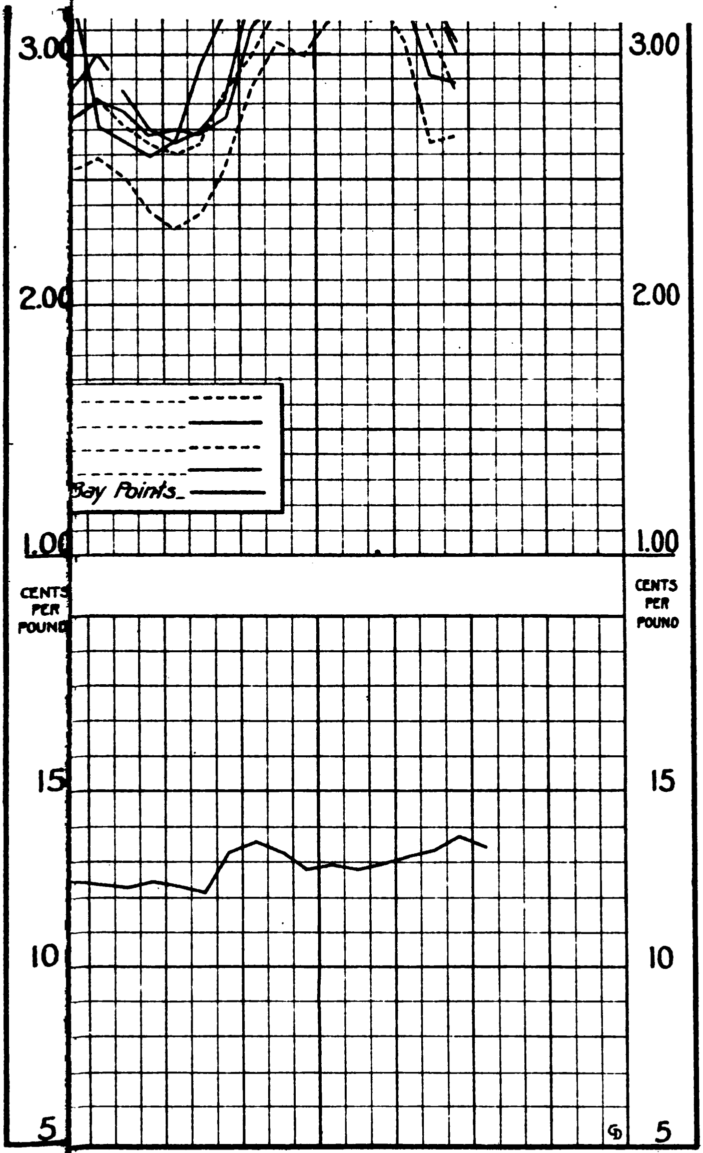

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TABLE 43.—AVERAGE PRICE, PER UNIT OF AMMONIA, OF DRIED FISH SCRAP, DELIVERED CHESAPEAKE BAY POINTS, BY MONTHS, 1907–1914.[1]

Month.	1907	1908	1909	1910	1911	1912	1913	1914
January	$2.70	....	....	....	....	....	$2.70	$3.44
February	2.73	....	....	....	$3.29	....	3.00	....
March	2.81	....	$2.74	$2.79	3.25	$3.00	3.30	3.65
April	2.98	$2.50	2.70	2.93	3.18	2.77	2.71	3.25
May	....	2.56	2.72	[2] 3.14	3.19	2.52	2.66	2.92
June	....	2.70	2.70	[2] 2.93	3.28	2.47	2.60	2.89
July	2.90	2.71	2.62	2.98	3.34	2.48	2.66	....
August	2.97	2.72	2.60	3.04	3.19	2.45	2.96	....
September	2.79	2.75	2.53	3.00	3.25	[3] 2.46	3.18	....
October	2.86	2.80	2.54	3.30	3.22	[3] 2.48	3.40	....
November	2.91	....	[2] 2.51	3.36	3.15	2.81	3.50	....
December	2.85	2.80	2.80	....	3.06	2.85	3.42	....

[1] Taken from sales through brokers unless otherwise noted.
[2] Taken from purchases by fertilizer manufacturers.
[3] Taken from sales by producers.

Price fluctuations.—As will be noted from the tables and diagram presented above, the prices of tankage, dried blood, and fish scrap fluctuate more rapidly than those of the inorganic ammoniates. There is usually a break in prices during the summer months and a recovery in the fall. In addition to these minor fluctuations which occur each year, there have been four major movements since the fall of 1909, which follow from eight months to a year after the major movements of cottonseed meal. During the year 1908 and the first half of 1909 the prices of tankage and dried blood in New York were between $2.50 and $2.77 per unit of ammonia, while in the Chicago market dried blood remained below $2.65 and tankage below $2.35 per unit. During this same period the prices of fish scrap ranged from $2.50 to $2.80 per unit of ammonia. From these low figures prices began to rise in the fall of 1909 and continued upward, except for the usual summer reaction in 1910, until about the first of February, 1911, when both tankage and dried blood sold above $3.35 per unit in the New York market, while in the Chicago market dried blood reached $3.20 and tankage $2.93 per unit of ammonia. Fish scrap reached its highest price of $3.36 in November, 1910. During the year 1911 the trend of prices was downward, the usual upward reaction occurring in the prices of dried blood and tankage in the fall of this year. The low prices for this downward movement, which were reached in the summer of 1912, were at about the same level as the low prices of 1909. From this low point reached in 1912 the recovery was gradual until after the summer decline of 1913, when a marked rise in prices occurred which continued until March, 1914. At the culmination of this movement dried blood in both the Chicago and New York markets went above $3.40 per unit, which is the highest price recorded in many years. Tankage also rose to about $3.45 per unit in New York and to $3.23 in Chicago, and fish scrap reached the record price of $3.65 per unit of ammonia.

Beginning in the spring of 1914 prices fell almost as rapidly as they had risen a few months before. By June, 1914, tankage had declined to about $2.65 per unit in Chicago and blood to about $2.85. Fish scrap had likewise declined to $2.89 per unit of ammonia. There was some recovery in prices in the fall of 1914, but the demoralization of the fertilizer industry caused by the outbreak of the European war greatly curtailed demand, so that comparatively few sales were made. In July, 1915, high-grade tankage sold as low as $2.20 per unit of ammonia f. o. b. Chicago and dried blood as low as $2.40 per unit, while in August fish scrap was quoted at $2.35 per unit. By October, 1915, considerable recovery had been made; tankage was quoted at $2.80 per unit of ammonia and dried blood at $3 per unit f. o. b. Chicago and dried fish scrap was quoted at $3.25 per unit f. o. b. factory.

Causes of major price fluctuations.—Among the factors which exert an important influence upon the prices of all the organic ammoniates are the ready substitution of one for the other, the increased use of cottonseed meal and tankage for stock food in recent years, and the varying demand for fertilizers, especially in the cotton States, which is influenced especially by the price of cotton. The prices of tankage, dried blood, and fish scrap appear to be particularly influenced by the prices of cotton and of cottonseed meal. The similarity of the course of prices of cotton and tankage, dried blood, and fish scrap is shown by Diagram 4 above.

Two factors were especially prominent in the rise in the price of tankage, dried blood, and fish scrap beginning in the fall of 1909. The cotton crop for this year was the smallest since 1903, causing high prices for cotton and a smaller production of cottonseed meal, the price of which had already begun one of its general upward movements in the first part of the year. The high prices for cotton stimulated the use of mixed fertilizers, while the shortage of cottonseed meal led to higher prices and consequent increased demand and higher prices for the other organic ammoniates which could be substituted for it in mixed fertilizers. In addition the slaughter of meat animals under Federal inspection in 1910 was the smallest since 1906, resulting in a diminished output of abattoir ammoniates.

The fall in the prices of tankage and dried blood, which began in the spring of 1911 and continued until the spring of 1912, was caused by conditions just the reverse of those mentioned above. The slaughter of cattle was larger than the year before and the menhaden catch was also large. Cottonseed-meal prices reached a low level during the first quarter of 1911, and as a result of the unusual cotton crop of 1911 became so cheap that in the fall of 1911 and the spring of 1912 it was extensively substituted for other organic ammoniates in mixed fertilizer and even to some extent for inorganic ammoniates, with the result that all during the fertilizer season the prices of blood and tankage continued to fall, producers' average prices for tankage going as low as $2.19 in Chicago and $2.70 in New York in April and for blood as low as $2.39 in Chicago and $2.74 in New York in May. The season of 1912 was also the poorest in recent years for the fertilizer manufacturers, since the low prices of cotton restricted the use of fertilizers.

In the summer of 1912 prices of blood, tankage, and fish scrap responded to the upward movement of cottonseed meal prices begun in January. By April, 1913, prices for tankage and blood sold by producers in Chicago had risen to about $2.59 and $2.81, respectively, and in New York to $2.81 and $3, respectively. After a sharp reaction during the summer months prices again rose rapidly until the following Spring. Several factors combined to cause this rise. There was an abnormal demand for cottonseed meal as a stock food, and the prices in all States from April, 1913, through the first half of 1914, remained at a higher level than for any similar number of consecutive months during the period covered by this study of prices. Tankage also was in demand for stock food. Swift & Co. sold more of their output for this purpose than they did for fertlizers, and other packers also disposed of much larger quantities for animal food than ever before. The fish-scrap season of 1913 was a very poor one, the total production being a third less than that of 1912. The cotton crop in 1913, while fairly large, brought good prices and led to an increased demand for fertilizers for the coming year.

During the summer of 1913, while prices were low, the packers, following their usual practice, accumulated supplies of tankage and dried blood. Many fertilizer manufacturers kept out of the market, believing that prices would go still lower. In the late summer it became apparent that the season's menhaden fish catch would be very small. During the latter part of August and the first part of September, after prices in the Chicago market had begun to rise, The American Agricultural Chemical Co. purchased, through brokers for both prompt and future delivery, large quantities of tankage. Their purchases in August and September, for delivery during the season, aggregated about 10,500 tons. In addition, a considerable quantity was purchased on yearly contracts. Early in September the Virginia-Carolina Chemical Co. came into the market and made large purchases. Other fertilizer manufacturers also rushed into the market, with the result that sales were made at rapidly advancing prices until, in March, 1914, the average prices on sales made by producers were $3.23 and $3.41 in Chicago for tankage and blood, respectively, and in New York $3.44 for tankage. The highest average price for dried blood in New York was $3.45, in April, 1914. The price of fish scrap rose simultaneously with that of the abattoir ammoniates, reaching $3.65 per unit in March, 1914.

The fall in the prices of tankage and dried blood which began in the spring of 1914 was a natural reaction from the high prices of March, but undoubtedly marked the beginning of a downward movement of some duration. The cotton crop of 1914 was the largest in history, being nearly 16,000,000 bales, and the production of cottonseed meal was greater than ever before. The twofold result of this was cheap cottonseed meal, which was reflected in lower prices for the other organic ammoniates on the one hand and curtailed plantings and consumption of fertilizer on the other.[1] The outbreak of the European war greatly restricted demand during the fall of 1914, especially for future delivery, so that the usual upward swing was not as large as formerly or as well maintained. In September high-grade tankage was quoted in the Chicago market at $3 per unit of ammonia and blood at $3.15. From these levels, beginning in October, prices began to sag until, in June, 1915, tankage sold at $2.15 per unit and blood at $2.40 in the Chicago market.

Influence of packers on prices.—As has already been stated (see p. 67), the five largest producers of tankage and blood sell the output of their numerous abattoirs through their main offices in Chicago, making that place the principal market for these materials. In addition, there are three other important producers selling through Chicago offices—John Morrell & Co., Globe Rendering Co., and Darling & Co. The Armour Fertilizer Works, Swift & Co., and Darling & Co. also purchase large quantities of tankage from numerous slaughtering establishments in the West and Middle West. The storage capacity of these large packers is practically unlimited, so that they are able to hold large quantities of tankage off the market during the summer months, when there is but little demand from the fertilizer manufacturers, and until they are able to determine the size and price of the growing cotton crop, which is a fair indication of the size of the next season's fertilizer business. This holding of tankage tends to lessen the usual summer drop in prices.

A part of the requirements of the large fertilizer manufacturers is secured from small producers on yearly contracts. Kingan & Co. (Ltd.), Indianapolis, Ind., probably the sixth largest producer of high-grade tankage in the United States, has for a long period sold on yearly contracts. The quantity this company offers is of such size that only the largest fertilizer manufacturers are able to handle it. This situation makes it easier for the packers to create an artificial scarcity of tankage during the season of greatest demand and, if conditions are favorable, temporarily to raise prices. If it were not for the competition of foreign tankage and nitrogenous manures and of other ammoniates, especially cottonseed meal, the packers would undoubtedly be able to exercise a much greater control over prices than they are able to do under existing conditions.

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[1] For the relative quantities of these organic fertilizers used see Chap. I, p. 6.

Section 6. Acid phosphate and phosphate rock.

Average monthly prices of 16 per cent bulk acid phosphate in four principal markets, together with the combined averages, are presented in Table 44 and shown graphically in Diagram 5, opposite page 152. These prices were obtained from producers, except for Baltimore, where brokers' prices have been substituted, since they were more complete. The prices are on an f. o. b. plant basis and include all deliveries, both prompt and future. Bulk acid phosphate is usually sold on contracts covering a number of shipments, so that it has not been found possible to attempt a tabulation of contract prices for prompt delivery, as has been done in the case of most of the nitrates and ammoniates.

TABLE 44.—AVERAGE PRICES PER NET TON, F. O. B. PLANT, OF 16 PER CENT BULK ACID PHOSPHATE FOR VARIOUS PLANTS, BY MONTHS, 1908–1914.

Month.	Georgia and South Carolina interior points.[1]	Nashville, Tenn.[2]	Savannah, Ga.[3]	Baltimore, Md.[4]	All points combined.
1908—January		$11.19			$11.19
February		11.01			11.01
March		10.46		$8.50	10.00
April		9.90		8.50	8.87
May		10.30		8.69	8.73
June		9.17		9.00	9.02
July		8.70			8.70
August		8.96		[5] 8.75	8.84
September		9.19		[5] 8.50	8.86
October		9.20		8.50	8.55
November		8.00		8.11	8.11
December		7.94		7.90	7.90
1909—January		8.09			8.09
February		9.79		[5] 7.75	9.73
March		9.62		7.75	8.89
April		9.19		7.89	8.84
May		8.31		7.99	8.00
June		8.03		[5] 7.75	7.88
July		7.85		[5] 7.70	7.78
August		8.36		8.00	8.26
September		8.12		8.00	8.10
October		8.02		[5] 7.70	7.79
November		8.25		7.50	7.53
December		7.83		7.80	7.81
1910—January		8.00		7.82	7.87
February		9.10		8.76	8.77
March		8.58		9.44	9.07
April		8.67		10.74	9.89
May		8.69		8.61	8.62
June		8.02		8.52	8.37
July	$8.00	8.48		8.77	8.65
August		8.89		8.27	8.38
September	8.00	8.96		8.58	8.63
October	8.04	8.66		8.61	8.26
November	7.99	9.82		8.50	8.14
December	8.02	8.48		8.80	8.26
1911—January	7.99	8.98		8.78	8.23
February	8.06	8.98		8.75	8.12
March	8.00	8.85		8.32	8.21

[1] Five plants located at Americus, Augusta, Atlanta, and Tifton, Ga., and Spartanburg, S. C.
[2] Three plants.
[3] Two plants.
[4] Broker's prices except as noted.
[5] Manufacturers' prices.

TABLE 44.—AVERAGE PRICES PER NET TON, F. O. B. PLANT, OF 16 PER CENT BULK ACID PHOSPHATE FOR VARIOUS PLANTS, BY MONTHS, 1908–1914—Continued.

Month.	Georgia and South Carolina interior points.	Nashville, Tenn.	Savannah, Ga.	Baltimore, Md.	All points combined.
1911—April	$7.97	$8.93	....	$8.24	$8.26
May	7.98	9.11	....	7.90	8.00
June	8.00	8.88	....	7.75	7.84
July	....	9.07	$8.67	7.85	8.52
August	....	9.10	8.50	8.19	8.28
September	7.98	9.05	8.36	8.21	8.41
October	8.00	9.15	8.28	7.96	8.10
November	8.00	8.90	8.46	7.43	7.66
December	8.00	8.71	8.41	7.50	7.64
1912—January	7.99	9.26	8.43	7.49	7.98
February	8.16	8.64	8.42	7.30	8.00
March	8.19	8.61	8.34	7.25	8.16
April	8.13	8.66	8.35	7.00	7.58
May	8.18	8.63	8.45	7.00	8.30
June	8.01	8.76	7.56	7.00	7.54
July	8.24	8.98	7.35	6.67	7.94
August	8.39	8.72	6.50	6.57	7.72
September	7.92	8.70	7.85	6.58	7.59
October	7.66	8.11	8.12	6.72	7.26
November	7.81	7.50	7.37	[1] 6.95	7.64
December	7.97	7.95	7.05	6.50	7.64
1913—January	8.06	7.40	6.85	6.61	7.51
February	8.06	7.71	6.61	6.46	7.29
March	8.03	7.39	6.54	6.73	7.68
April	8.07	7.29	6.65	6.76	7.72
May	7.98	7.62	7.03	6.58	7.23
June	7.74	7.57	6.80	6.63	7.09
July	7.59	7.23	6.23	6.71	6.45
August	7.53	7.51	6.45	6.75	6.95
September	7.75	7.66	7.26	6.85	7.62
October	7.60	7.41	7.15	6.55	7.17
November	7.68	6.85	7.18	[1] 6.91	7.28
December	7.42	7.15	6.92	6.58	7.19
1914—January	7.56	7.37	6.36	....	7.19
February	7.49	7.21	5.90	6.75	7.09
March	7.57	7.23	5.75	7.00	7.10
April	7.50	7.35	5.74	7.25	7.20
May	8.05	7.26	7.28	6.51	7.12
June	7.74	8.73	7.84	6.70	6.95

[1] Manufacturers' prices.

In Tables 45 and 46 below are given high, low, and mean prices per gross ton at mines by months of Florida phosphate rock for the period 1907 to 1914 and of Tennessee rock for the period 1910 to 1914, to accompany the prices of acid phosphate given in Table 44. The mean prices are also shown graphically in Diagram 5. These prices were taken from the contracts of mining companies for sales to domestic purchasers. All sales were taken, since prompt transactions in this raw material are rare. A single contract may cover several years and call for the delivery of thousands of tons. The range of contract prices by months rather than the average is given because of the comparatively small number of sales. The prices for Florida are for land-pebble rock, averaging from 68 per cent to 70 per cent of tricalcium phosphate; those for Tennessee are for brown rock, averaging from 72 per cent to 75 per cent of tricalcium phosphate, unless otherwise noted.

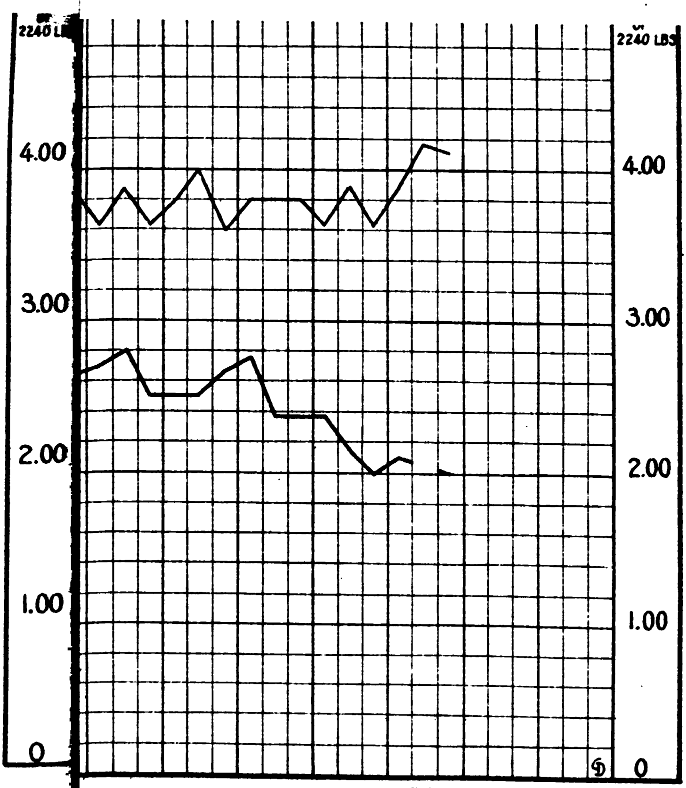

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Table 45.—HIGH, LOW AND MEAN CONTRACT PRICES PER GROSS TON OF FLORIDA LAND PEBBLE PHOSPHATE ROCK, AT MINES, BY MONTHS, 1908–1914.

[68 to 70 per cent grades, unless otherwise noted.]

Year.	Months.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	ept.	Oct.	Nov.	Dec.
1908—High	......	$4.65	$3.75	$3.50	$3.50	$3.50	$3.50	$3.25	$3.30	$3.25	$3.75	$3.00
Low	......	3.50	3.25	3.25	3.25	3.00	3.00	3.10	3.30	3.00	3.00	3.00
Mean	......	4.08	3.50	3.38	3.38	3.25	3.25	3.18	3.30	3.13	3.38	3.00
1909—High	......	3.00	3.00	3.50	2.92	[1]3.31	......	3.25	4.25	2.88	[1]3.77	[1]3.04
Low	......	2.85	2.85	[1]2.78	[1]2.72	[1]2.79	......	3.00	2.85	2.75	3.00	2.80
Mean	......	2.93	2.93	3.14	2.82	[1]3.05	......	3.13	3.55	2.81	3.39	2.92
1910—High	$3.00	......	[1]3.24	[1]3.53	2.75	[1]3.62	3.25	3.60	3.25	3.25	[1]3.64	3.25
Low	2.85	......	3.00	[1]3.32	2.75	2.95	2.75	2.75	2.25	2.75	[1]3.07	2.75
Mean	2.93	......	3.12	[1]3.43	2.75	3.29	3.00	3.18	2.75	3.00	[1]3.36	3.00
1911—High	3.25	3.25	3.25	3.25	3.25	3.25	3.80	3.25	3.25	3.25	[1]3.26	3.25
Low	3.25	2.75	2.75	2.75	2.75	3.25	2.90	2.75	2.75	2.75	[1]3.03	2.85
Mean	3.25	3.00	3.00	3.00	3.00	3.25	3.35	3.00	3.00	3.00	[1]3.15	3.05
1912—High	[1]3.49	3.25	[1]3.25	[1]3.07	3.25	3.50	2.80	2.80	2.80	2.80	2.80	2.80
Low	2.70	2.85	2.75	[1]2.74	2.65	2.75	2.70	2.70	2.80	2.80	2.80	2.50
Mean	3.10	3.05	3.00	[1]2.91	2.95	3.13	2.75	2.75	2.80	2.80	2.80	2.65
1913—High	2.75	2.80	2.75	2.98	[1]2.94	2.75	2.75	2.75	2.75	2.75	2.75	2.75
Low	2.75	2.75	2.50	2.40	2.65	2.25	2.25	2.25	[1]2.55	2.75	2.00	2.00
Mean	2.75	2.78	2.63	2.69	2.80	2.50	2.50	2.50	2.65	2.75	2.38	2.38
1914—High	2.75	2.15	2.00	2.20	......	2.00	......	......	......	......	......	......
Low	2.00	2.15	2.00	2.00	......	2.00	......	......	......	......	......	......
Mean	2.38	2.15	2.00	2.10	......	2.00	......	......	......	......	......	......

[1] 70 to 74 per cent grade.

Table 46.—HIGH, LOW, AND MEAN CONTRACT PRICES PER GROSS TON OF TENNESSEE BROWN PHOSPHATE ROCK, AT MINES, BY MONTHS, 1910–1914.

[72 to 75 per cent grades.]

Year.	Months.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910—High	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$4.00	$4.30	$4.00	$4.10	$4.00	$4.00
Low	3.00	3.35	3.00	3.00	3.35	3.35	3.00	3.35	3.00	3.00	3.00	3.00
Mean	3.25	3.43	3.25	3.25	3.43	3.43	3.50	3.83	3.50	3.55	3.50	3.50
1911—High	4.00	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.00	4.00	4.10	4.10
Low	3.00	3.00	3.50	3.50	3.50	3.00	3.00	3.00	3.00	3.00	3.50	3.00
Mean	3.50	3.55	3.80	3.80	3.80	3.55	3.55	3.55	3.50	3.50	3.80	3.55
1912—High	4.30	4.25	4.25	4.25	4.50	4.25	4.25	4.25	4.25	4.25	4.25	4.25
Low	3.00	4.25	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Mean	3.65	4.25	3.63	3.63	3.75	3.63	3.63	3.63	3.63	3.63	3.63	3.63
1913—High	4.30	4.25	4.25	4.25	4.25	4.25	4.00	4.00	3.60	4.00	4.00	4.00
Low	3.00	3.50	3.50	3.00	3.50	3.00	3.60	4.00	3.60	3.60	3.60	3.60
Mean	3.65	3.88	3.88	3.63	3.88	3.63	3.80	4.00	3.60	3.80	3.80	3.80
1914—High	4.25	4.25	4.25	4.25	4.25	4.25	......	......	......	......	......	......
Low	3.00	3.50	3.00	3.50	4.10	4.00	......	......	......	......	......	......
Mean	3.63	3.88	3.63	3.88	4.18	4.13	......	......	......	......	......	......

Price fluctuations.—As shown in Table 45 and Diagram 5, the price of 16 per cent bulk acid phosphate has been falling gradually since about January 1, 1912. In 1910 and 1911 prices f. o. b. manufacturing plants kept above $8 per net ton during most of the time, while since January, 1912, they have remained almost continuously below this figure. In the Baltimore and Savannah markets prices were below $7 per ton for most of the year 1913, while in the latter market in 1914 the price went below $6 per ton, which was considerably less than the average cost of production of three important plants. (See p. 93.) During the year 1915 prices rose from $7.25

per ton in January in the Baltimore market to $14 a ton in November. There does not appear to be any regular seasonal movement in the prices of acid phosphate.

The prices of Florida phosphate rock at the mines presented in Table 45 also show in general a gradual downward trend similar to that of acid phosphate prices. In 1907 Florida pebble rock is said to have sold above $7 per ton. The highest price shown in the table for 1908 was $4.65 and the lowest $3 per ton. In the first half of 1914 the highest price was $2.75 and the lowest $2 a ton, which was less than the actual cost of production of some mines. (See p. 101.) Since July 1, 1914, sales below $2 a ton for the 68 per cent grade have been reported. The mean prices of Tennessee rock presented in Table 46 show a gradual upward trend since 1910.

Causes of the decline.—The years 1910 and 1911 were prosperous ones for the fertilizer manufacturers, who are the principal producers and also users of acid phosphate, so that the surplus quantities of this material which they sold to the trade were not large and brought fairly good prices. There was a great expansion in the industry as a result of these prosperous years and a large number of new acid plants were built. The lead chambers used in manufacturing sulphuric acid can only be operated economically by running continuously. It is stated that rapid deterioration takes place as soon as they are cooled down. The greatly increased output of sulphuric acid resulting from this expansion had to be converted into acid phosphate, it being very expensive to store the acid in large quantities, and the acid phosphate thus produced, beyond what was needed to supply the retail trade, had to be sold in bulk in order to make room for other materials and to turn it into cash.

In 1912 the demand for acid phosphate and other fertilizers fell off in the United States, while as noted above large additions were being made to the output. To make matters worse the International Agricultural Corporation, in order to dispose of the rapidly increasing supply of the sulphuric acid which it had contracted to take from the Tennessee and Ducktown copper companies, converted large quantities into acid phosphate, causing a further overproduction of this material.

The decline in Florida phosphate-rock prices has also been due to overproduction. The high prices prior to 1908 caused an expansion in the mining industry, and the desire of companies with large plant investment to keep them in operation and the inability to market the surplus in Europe at profitable prices has resulted in creating a large surplus for the domestic market. The overproduction of phosphate rock has contributed to the overproduction of acid phosphate since the surplus rock can be disposed of only by converting it into acid phosphate. At least one mining company has gone into the acid-phosphate business in order to dispose of its output.

The stability of Tennessee rock prices has been due mainly to the much smaller quantity mined and the advantage of location with respect to the Central States.

Section 7. German potash salts.

Owing to the manner in which potash salts are sold in this country by the German Potash Syndicate, it is only necessary in studying wholesale prices to take the list prices fixed for the United States less discounts. These syndicate prices, which are presented in Table 47, are c. i. f. Atlantic ports and cover the period from January 1, 1910, to June 30, 1914. By way of comparison the prices of potash salts fixed by the Schmidtmann contracts are also given for the year 1910. (See p. 109.)

TABLE 47.—WHOLESALE PRICES PER NET TON OF POTASH SALTS, C. I. F. ATLANTIC PORTS, 1910–1914.

Potash salts.	Schmidtmann prices, 1910 and 1911.			Syndicate prices.		
				January–June, 1910.		
	F. o. b. mines.	Additional charges.[1]	C. i. f. Atlantic ports.	List.	3 per cent discount.	Net.
Concentrated salts:						
Muriate	$15.54	$4.86	$20.40	$34.00	$1.02	$32.98
Sulphate	20.94	4.86	25.80	40.00	1.20	38.80
Double manure	9.28	4.86	14.14	21.00	.63	20.37
30 per cent manure	8.42	4.86	13.28	....	....	....
Crude salts:						
Kainit	1.92	3.24	5.16	7.25	.22	7.03
Hartsalz	2.48	3.24	5.72	9.00	.27	8.73
20 per cent manure	3.89	3.24	7.13	12.00	.36	11.64

Potash salts.	Syndicate prices.						
	July, 1910–April, 1911 net.	May, 1911–December, 1913.			January–June, 1914.		
		List.	Discount.[2]	Net.	List.	Discount.[2]	Net.
Concentrated salts:							
Muriate	$35.75	$38.05	$5.71	$32.34	$39.07	$5.86	$33.21
Sulphate	43.50	46.30	6.95	39.35	47.57	7.14	40.43
Double manure	22.75	24.45	3.67	20.78	25.04	3.76	21.28
30 per cent manure	....	19.15	2.87	16.28	19.63	2.94	16.69
Crude salts:							
Kainit	7.50	8.25	1.28	6.97	8.36	1.30	7.06
Hartsalz	9.70	10.65	1.65	9.00	10.87	1.68	9.19
20 per cent manure	12.25	13.30	2.06	11.24	13.58	2.10	11.48

[1] Concentrated salts: $1.188 per net ton for bagging and $3.670 for insurance, freight, etc., mines to Atlantic ports. Crude salts: $3.239 for insurance, freight, etc., mines to Atlantic ports.

[2] 15 per cent discount on concentrated and 15½ per cent on crude salts.

The syndicate prices in January, 1910, were $32.98 net for muriate and $7.03 for kainit, while the corresponding Schmidtmann prices at that time were $20.40 and $5.16, respectively. After the passage of the German potash law of 1910 the syndicate prices were raised to $35.75 per ton for muriate and $7.50 for kainit, and the shipments of potash under the Schmidtmann contracts were subject to a heavy excess tax. (See p. 112.) With the settlement of the potash controversy the list prices to the United States were increased, but the discounts were graded, so that for quantities in excess of 20,000 tons of potash (K_2O) they amounted to 15 per cent on concentrated and 15½ per cent on crude salts, bringing the net prices for the five large contracts below the net price in effect prior to April 30, 1911. On January 1, 1914, the list prices were again raised, while the discounts remained unchanged, so that the net prices on the five large contracts were $33.21 per ton for muriate and $7.06 per ton for kainit. Since the outbreak of the European war resale prices for muriate in this country have risen above $450 a ton and of kainit above $40 a ton.

As has already been pointed out, potash salts are the only fertilizer materials whose wholesale prices are not controlled mainly by competitive market conditions. The ability of the syndicate to maintain monopoly prices is due to legislation preventing competition among the mines in Germany and to the absence of commercially available potash supplies in other countries.

Section 8. Comparative prices of nitrates and ammoniates.

In this section is presented a comparison of the prices of the six principal nitrogenous materials on the basis of their nitrogen content. The nitrate of soda prices used were for spot transactions and Baltimore delivery, while the sulphate of ammonia prices were computed by combining the prompt transactions of importers and brokers for foreign and domestic sulphate f. o. b. Atlantic ports, which are given in Tables 36 and 37 (see pp. 131 to 133). The prices for these two inorganic materials are thus on practically the same basis. In the case of tankage and dried blood the sales of the Chicago packers and brokers presented in Table 40 have been combined and the cost of freight per unit of ammonia from Chicago to Baltimore added to the f. o. b. Chicago price. For tankage this freight cost is 40 cents and for dried blood 26 cents per unit of ammonia. (See p. 75.) The dried fish scrap prices used were computed by combining the sales of brokers and the purchases of the principal manufacturers for deliveries to Chesapeake Bay points, so that these prices are also on a comparable basis with the others, except that as explained above (see p. 145) it has been necessary to take all sales for delivery during a given season rather than prompt transactions only.

The prices of cottonseed meal used were computed by combining the wholesale prices for Georgia and Alabama presented in Table 38 (see p. 139) and deducting $1.50 per ton for the phosphoric acid and potash content. This meal is used largely in the neighborhood of the mills producing it, so that no addition to the prices has been made for freight. The prices are, therefore, not entirely comparable with those for the other materials. To put cottonseed meal on a seacoast basis a small freight cost of perhaps 20 or 25 cents per unit of ammonia should be added. This would vary somewhat, depending upon the location of the mill. If the prices of tankage and dried blood were put on a Georgia-Alabama basis a freight cost a few cents higher per unit of ammonia than to Baltimore should be added to the Chicago prices.

A comparison of the average monthly prices per unit of nitrogen of the principal fertilizer materials is presented in Table 48 and shown graphically in Diagram 6, opposite page 158.

TABLE 48.—COMPARISON OF AVERAGE MONTHLY PRICES PER UNIT OF NITROGEN OF THE PRINCIPAL ORGANIC AND INORGANIC NITRATES AND AMMONIATES, 1909–1914.

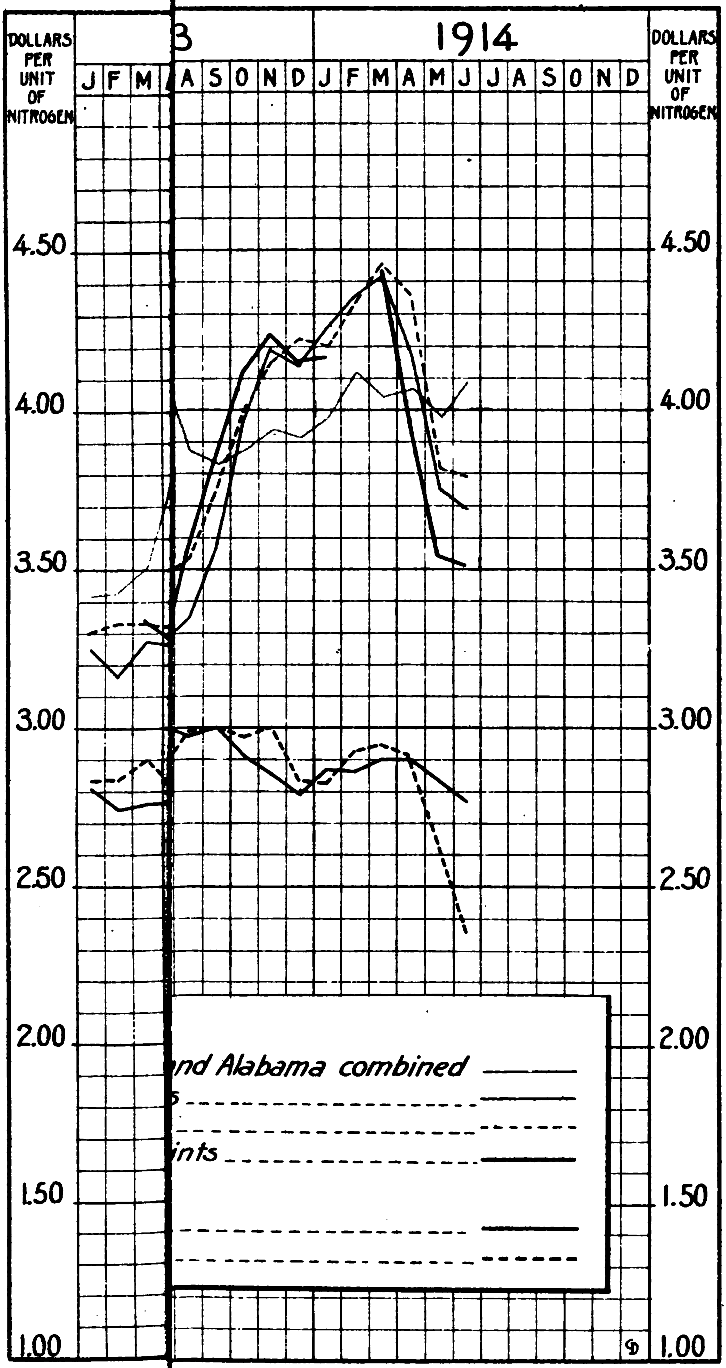
Month.	Inorganic materials.		Organic materials.			
	Nitrate of soda.	Sulphate of ammonia.	High-grade tankage	Dried blood.	Dried fish scrap.	Cottonseed meal.
1909—January	$2.81	$2.83	$3.25	$3.30	....	$3.41
February	2.74	2.84	3.17	3.32	....	3.42
March	2.77	2.90	3.28	3.32	$3.34	3.50
April	2.77	2.80	3.26	3.31	3.27	3.83
May	2.78	2.77	3.20	3.31	3.31	4.07
June	2.74	2.77	3.28	3.26	3.28	4.42
July	2,75	2.68	3.22	3.27	3.21	4.37
August	2.72	2.53	3.33	3.28	3.19	4.15
September	2.71	2.56	3.29	3.31	3.11	3.79
October	2.70	2.53	3.31	3.35	3.14	4.05
November	2.69	2.53	3.63	3.69	3.05	4.23
December	2.68	2.53	3.69	3.83	3.41	4.33
1910—January	2.68	2.60	3.83	3.88	....	4.43
February	2.68	2.65	3.81	3.87	....	4.54
March	2.74	2.75	3.85	4.00	3.38	4.39
April	2.77	2.66	4.09	4.13	3.53	4.38
May	2.77	2.61	3.65	3.85	3.82	4.09
June	2.72	2.54	3.49	3.55	3.56	3.96
July	2.71	2.61	3.59	3.62	3.60	3.69
August	2.71	2.67	3.74	3.78	3.64	3.73
September	2.73	2.76	3.93	4.08	3.63	3.85
October	2.75	2.76	4.02	4.18	3.89	3.95
November	2.74	2.85	4.07	4.18	3.73	3.89
December	2.72	2.77	3.89	4.15	....	4.03
1911—January	2.69	2.90	4.05	4.21	....	3.95
February	2.69	2.89	4.03	4.31	4.00	3.85
March	2.69	2.99	3.91	4.25	3.95	3.84
April	2.70	2.92	3.66	3.88	3.86	3.76
May	2.74	2.92	3.65	3.74	3.89	3.75
June	2.76	2.88	3.85	3.84	3.98	3.72
July	2.78	2.99	3.92	3.99	4.04	3.62
August	2.79	3.05	3.60	3.84	3.90	3.52
September	2.86	3.05	3.78	3.99	3.95	3.57
October	2.87	3.10	3.71	3.99	3.91	3.62
November	2.83	3.12	3.64	3.91	3.84	3.62
December	2.83	3.11	3.56	3.90	3.71	3.42
1912—January	2.83	3.14	3.49	3.86	....	3.37
February	2.84	3.12	3.15	3.47	....	3.60
March	2.94	3.18	3.18	3.51	3.65	3.73
April	3.10	3.19	3.14	3.38	3.36	3.77
May	3.10	3.17	3.19	3.20	3.07	3.66

TABLE 48.—COMPARISON OF AVERAGE MONTHLY PRICES PER UNIT OF NITROGEN OF THE PRINCIPAL ORGANIC AND INORGANIC NITRATES AND AMMONIATES, 1909-1914—Continued.

Month.	Inorganic materials.		Organic materials.			
	Nitrate of soda.	Sulphate of ammonia.	High-grade tankage.	Dried blood.	Dried fish scrap.	Cottonseed meal.
1912—June	$3.12	$3.17	$3.25	$3.33	$2.99	$3.77
July	3.15	3.16	3.42	3.34	3.01	3.75
August	3.17	3.17	3.51	3.37	3.03	3.73
September	3.26	3.21	3.23	3.41	3.00	3.52
October	3.29	3.05	3.26	3.38	3.01	3.50
November	3.33	3.08	3.32	3.40	3.41	3.56
December	3.35	3.15	3.36	3.45	3.42	3.78
1913—January	3.34	3.21	3.37	3.52	3.28	3.88
February	3.40	3.24	3.37	3.49	3.65	3.82
March	3.39	3.19	3.55	3.63	4.01	3.82
April	3.37	3.02	3.60	3.73	3.31	3.97
May	3.28	2.92	3.53	3.61	3.26	4.18
June	3.15	2.89	3.37	3.54	3.16	4.20
July	3.01	2.86	3.27	3.48	3.19	4.12
August	2.98	2.99	3.35	3.53	3.55	3.88
September	3.00	3.00	3.57	3.75	3.84	3.83
October	2.91	2.98	3.97	3.99	4.12	3.88
November	2.86	3.00	4.19	4.16	4.24	3.94
December	2.79	2.84	4.14	4.22	4.16	3.91
1914—January	2.88	2.82	4.26	4.20	4.18	3.98
February	2.87	2.92	4.35	4.32	....	4.11
March	2.90	2.95	4.41	4.46	4.44	4.04
April	2.90	2.91	4.18	4.37	3.95	4.07
May	2.83	2.63	3.75	3.81	3.55	3.98
June	2.78	2.37	3.69	3.79	3.51	4.09

The table and diagram show that on the whole the two inorganic materials, nitrate of soda and sulphate of ammonia, are much cheaper per unit of nitrogen content than the four organic ammoniates, and that cottonseed meal is usually higher in price than any of the other organic ammoniates, and therefore the most expensive of any of the six materials under consideration.

Nitrate of soda and sulphate of ammonia on the whole pursue the same general price course, seldom showing wide divergencies. This course is quite independent of the course of the prices of organic ammoniates. For reasons that have already been discussed (see p. 134) sulphate of ammonia shows more frequent and more violent fluctuations than nitrate of soda. For most of the period covered by the accompanying diagram its course has been above that of nitrate. In May, 1909, the price of the two intersected at about $2.77, when both materials were following a downward movement. Sulphate, as is usual, was making a more rapid descent, so that it passed below nitrate and continued at a lower level until March, 1910. The maximum difference in price per unit during this period was about 19 cents, which occurred in August, 1909, when nitrate stood at $2.72 and sulphate at $2.53. From September, 1910, to July, 1912, sulphate of ammonia remained continuously above nitrate, the maximum difference in price reached being about 31 cents per unit of nitrogen in January, 1912. During the period from September, DIA D AMMONIATES, UNITED STATES,



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e Federal Trade Commission on the Fertilizer Industry

1912, until July, 1913, a wide divergence in the prices of the two inorganics occurred, the maximum difference reaching about 36 cents per unit in May, 1913, when nitrate stood at $3.28 and sulphate at $2.92.

The divergence in the prices of the two inorganics is due mainly to the fact referred to above (see p. 135), that the price of sulphate responds more quickly to changes in the demand for fertilizer than that of the nitrate and, for this reason, usually precedes the price movement of nitrate by several months. Thus, in the upward movement of the inorganics which began in 1910 and 1911 sulphate was the first to rise and rose more rapidly during the first part of the movement, the unit price remaining above that of nitrate for over a year, while during the last year of the upward movement nitrate of soda rose rapidly and continued to rise after sulphate had begun to decline, the unit price remaining above that of sulphate for a considerable period. The wide disparity in the unit prices of these two inorganics during the culmination of the nitrate rise was due to the abnormally high prices of nitrate caused by vessel shortage, speculation, etc. (See p. 127.)

The table and diagram show that there have been only two periods when the unit price of cottonseed meal fell below that of some of the other organic ammoniates. The first was during the last half of 1910 and all of the year 1911, and the second was from September, 1913, to May, 1914. The higher price generally paid for cottonseed meal is due to its demand for stock food, which factor often causes the price to run contrary to that of the other organics. Thus, in 1910 and 1911 the increased demand for fertilizer resulted in higher prices for blood, tankage, and fish scrap, while low corn prices tended to keep the price of cottonseed meal down. Again, in 1913 and 1914, a better demand for fertilizer, as shown by the heavy purchase of the organic materials by the manufacturers and a scarcity of fish scrap, caused a sharp rise in the price of the animal ammoniates, so that they rose above the unit price of cottonseed meal.

Tankage and fish scrap are on the whole cheaper per unit of nitrogen than blood, since the supply of the latter is much smaller, and it is more readily available in the soil and more efficient than the other animal ammoniates. It also supplies more units of nitrogen to the ton. The demand for tankage as a cattle food, however, is increasing rapidly, and in time may cause the price per unit to exceed that of dried blood.

The production of fish scrap is seasonal and the output is nearly always problematical, so that in seasons when the supply is short tankage is likely to take its place, as the nitrogen content and efficiency of the two are about the same. Not infrequently the price of fish scrap will advance beyond both blood and tankage, especially when there is a sudden demand at the close of the fertilizer season and when both the animal ammoniates and fish scrap are scarce. There is a well-defined preference on the part of many farmers for fish scrap, which the fertilizer manufacturers state it is necessary to satisfy.

The diagram shows that on the whole the organic ammoniates remain at a much higher price level than the inorganics. The widest divergence was in February, 1910, when the margin between the prices of cottonseed-meal and sulphate of ammonia was about $1.90 per unit of nitrogen, and in April, 1910, and March, 1914, when the price of dried blood was about $1.50 above that of sulphate. The only period of contact of the curves was from March, 1912, to June, 1913, when, as a result of a rise in the price of the inorganics simultaneously with a decline in the price of the organics, the unit price of tankage fell below that of sulphate in April, 1912, and that of nitrate in September, October, and November, 1912, and February, 1913, and the price of fish scrap fell below that of both nitrate and sulphate for several successive months in 1912 and at three different times in the first half of 1913.

Several causes combine to keep the price per unit of nitrogen in the organic ammoniates above the price of the inorganics. All the animal ammoniates, and fish scrap in particular, have a peculiar odor which has so long been associated with mixed fertilizer that consumers have come to believe that fertilizers which do not have this smell are worthless. Much faith is also attached to fertilizers in which the bright yellow of cottonseed-meal can be seen, so that manufacturers are obliged to use a good grade of meal when a dark off-grade is just as valuable for fertilizer. While the efficiency of the organic ammoniates is not as great as that of the inorganics, they have the virtue of yielding their nitrogen more slowly than do the inorganics, so that their effect is distributed over a longer period, which is an important consideration in extensive farming where labor costs are high and frequent applications of fertilizer expensive. Furthermore, organic ammoniates are said to be better for the soil than inorganics, as the latter tend to produce acids which may become injurious. Hence, longer use and prejudice, slower chemical action in the soil, and more salubrious effects in the long run combine to create a preference and to hold the prices per unit of nitrogen for organic ammoniates above those of the inorganic ammoniates.

CHAPTER VII.

COMPARISON OF WHOLESALE PRICES AND FARMERS' PRICES OF FERTILIZER MATERIALS.

Section 1. Introduction.

The prices of fertilizer materials which have been discussed in Chapter VI represent what the important fertilizer manufacturers who purchase in large quantities pay for the materials used in the manufacture of mixed goods or in filling orders for materials in unmixed form. In this chapter there is presented for comparative purposes data regarding the prices paid by farmers for fertilizer materials.

Approximately 80 per cent of the fertilizers purchased by farmers are in mixed form. (See p. 170.) In certain sections of the country, however, especially in the southern States, cottonseed meal, acid phosphate, muriate of potash, kainit, and nitrate of soda are purchased in large quantities by farmers who do their own mixing or apply the materials to the soil in unmixed form. In Georgia, for example, one of the States requiring the sellers to report daily shipments of goods sold to consumers, the returns obtained indicate the following sales of fertilizer materials for the year ending September 30, 1914:

Material.	Tons.	Per cent of total sales of fertilizer.
Cottonseed meal	148,281	10.4
16 per cent acid phosphate	67,054	4.7
Kainit	46,284	3.2
Nitrate of soda	22,180	1.5
Muriate of potash	9,103	.6
Miscellaneous materials	2,180	.2
Total	295,082	20.6

The total sales of fertilizers including cottonseed meal as indicated by the number of tags sold by the Georgia Department of Agriculture during the year ending September 30, 1914, was 1,430,379 tons. Cottonseed meal, sold for feeding purposes, requires a special stamp tax and is not included in the above figures.

Returns from Georgia indicate that the bulk of the materials used by consumers are sold by the fertilizer manufacturers. For instance, the seven largest companies (including their subsidiaries and affiliated companies) distributed to consumers in Georgia during the period October 1, 1913, to December 31, 1914, the following quantities of materials: 16 per cent acid phosphate, 19,012 tons; kainit, 16,439 tons; muriate of potash, 2,347 tons; nitrate of soda, 8,194 tons; miscellaneous materials, 887 tons. They also sold 19,049 tons of cottonseed meal. These fertilizer materials are distributed to farmers by the manufacturers either directly or through local dealers. The terms of sale are the same as for mixed fertilizers (see p. 216). If sold for cash May 1 a discount of 5 per cent is allowed from the list price. If sold on time, a note is usually taken, due at some date between September 15 and December 1, depending upon the circumstances.

In the North as well as in the South fertilizer materials are also distributed to the farmer by various importing and distributing concerns which make a specialty of this business. The sales of these concerns are on a cash basis, so that they are patronized largely by the better class of farmers who purchase in considerable quantities. There is often keen competition between these concerns and the fertilizer manufacturers for this cash business. The latter prefer to sell the farmer mixed fertilizers, but will usually sell him materials rather than lose his trade. These distributing concerns solicit a considerable portion of their business through the mails, and, owing to the low prices at which their goods are sold as compared with the list prices of the manufacturers, they have received a large share of the cash trade.

As a result of the different methods of distributing fertilizer materials, several kinds of prices may be distinguished. There are, in addition to the wholesale prices presented in Chapter VI, cash prices to merchants or farmers for sales by distributing concerns, list prices of fertilizer manufacturers to dealers which are generally subject to discounts and cash or credit prices charged by dealers or manufacturers for sales to farmers. In order to determine the relation of the wholesale prices to the various other prices which result from the different methods of distribution, the Federal Trade Commission collected a considerable amount of price data from distributing concerns, merchants, and farmers. The difficulties of obtaining complete information regarding farmers' prices and of treating such price data statistically made it inadvisable to present the subject with the same detail as was done in the case of wholesale prices. The conclusions of this investigation, however, are presented herewith in as much detail as possible.

Section 2. Farmers' prices of fertilizer materials.

Information collected by the Commission shows that what a farmer pays for his fertilizer materials depends upon how and where he buys them. A farmer or farmers' club which can buy in large quantities and pay cash obtains its materials at prices that compare favorably with the wholesale prices paid by the large fertilizer manufacturers. A farmer who buys in small quantities or on time pays a much higher price. In his case the price paid is governed to considerable extent by his credit standing. As a result of these conditions wide variations in farmers' prices even in the same localities have been found.

In order to ascertain what farmers were actually paying for their fertilizer materials, cash prices for sales of nitrate of soda, 16 per cent acid phosphate, kainit, and muriate to farmers and merchants f. o. b. Norfolk, Charleston, and Savannah were obtained from two of the largest distributing concerns for the first half of 1914 and monthly averages for ton lots and less than ton lots computed. While these concerns sell considerable quantities of materials to dry mixers and small fertilizer manufacturers, only sales to merchants and farmers were used in computing these monthly averages. The sales to merchants were not separated from those to farmers, for the reason that they could not be distinguished on the contracts and invoices, and for the further reason that in some cases the merchant and farmer were one and the same. The terms of sale, however, are practically alike for both, so that the elimination of the merchants' prices was not necessary for accuracy.

The sales of these two concerns cover the territory extending from Virginia to Florida, including eastern Alabama. The prices for sales to purchasers in Florida were found, as a rule, to be somewhat higher than those in the other States, and are therefore shown separately. The variations in prices shown for the territory covered are due to competitive conditions, quantity purchased, location of purchaser, etc. The shipments were mainly to the truck, tobacco, fruit, and certain cotton-growing sections of the States mentioned. Thus in Georgia very few sales were made in the portion north of a line drawn across the State through Athens and Atlanta. In North Carolina the greater part of the shipments were made to the territory south and east of a line extending from Jackson (Northampton County) southwesterly through Raleigh and Charlotte. In South Carolina most of the shipments were to the northern and southwestern portions of the State, very few being made to the northwestern tier of counties or to the tier extending along the Atlantic seaboard. In Florida the shipments were largely to the fruit and truck sections in the southern portion, numerous sales being made to Dade, Hillsboro, Manatee, Orange, and Volusia Counties.

Prices paid for the same fertilizer materials in 1914 were also obtained directly from a number of farmers located in towns extending from Lumberton, N. C., southwest to Bamberg, S. C., and from Spartanburg, in northern South Carolina, to Athens in northeast Georgia. These prices are for cash in some instances and credit in others, and are those paid to dealers and to fertilizer manufacturers by the better class of farmers. Information obtained from various sources indicates that they are somewhat lower than the prices usually paid by tenants and small farmers. A comparison of these prices with the cash prices of the distributing concerns shows the saving possible by cash purchases.

Nitrate of soda.—Table 49, following, compares the wholesale spot prices of nitrate of soda c. i. f. Baltimore and Charleston with the cash prices f. o. b. Norfolk, Charleston, and Savannah to merchants and farmers.

TABLE 49.—COMPARISON OF AVERAGE WHOLESALE SPOT PRICES OF NITRATE OF SODA C. I. F. BALTIMORE AND CHARLESTON, WITH AVERAGE CASH PRICES OF DISTRIBUTORS TO MERCHANTS AND FARMERS F. O. B. NORFOLK, CHARLESTON, AND SAVANNAH, BY MONTHS, JANUARY TO JUNE, 1914.

Month.	Wholesale spot price per ton.		Average cash prices, bagged and tagged, to merchants and farmers.						
			Ton lots.				Less than ton lots.		
			Va., N. C., S. C., Ga., and Ala.			Florida.[1]	Va., N. C., S. C., Ga., and Ala.		Florida.[1]
	C. i. f. Baltimore.	C. i. f. Charleston.	F. o. b. Norfolk.	F. o. b. Charleston.	F. o. b. Savannah.	F. o. b. Savannah.	F. o. b. Norfolk.	F. o. b. Savannah.	F. o. b. Savannah.
January	$44.66	$45.50	$45.64	$45.46	$47.41	$48.35	$53.20	$51.25	$52.62
February	44.42	45.02	45.83	45.46	46.80	48.57	52.26	50.73	52.58
March	44.94	45.04	46.28	45.42	46.78	47.91	52.45	48.52	52.54
April	45.00	44.20	47.01	45.56	46.86	48.11	49.73	48.10	53.24
May	43.90	43.50	46.40	44.48	46.65	50.11	48.57	47.46	52.07
June	43.02	42.88	46.27	42.82	46.70	50.81	48.59	47.29	52.56

[1] The prices to merchants and farmers in Florida were tabulated separately because they were somewhat higher than those to merchants and farmers in Georgia and Alabama.

The prices in ton lots f. o. b. Charleston were uniformly lower than those for either Norfolk or Savannah. During the month of June they were lower than the average wholesale spot price at either Baltimore or Charleston. The average prices to merchants and farmers f. o. b. Norfolk rose from $45.64 in January to $47.01 in April, and then declined to $46.27 per ton in June. At Charleston the prices declined from $45.46 in January and February to $42.82 in June, except for April, when $45.56 was the average price. At Savannah the f. o. b. price to merchants and farmers in this territory declined from $47.41 in January to $46.65 in June, while those to merchants and farmers in Florida were lowest in March at $47.91 and highest in June at $50.81. Average prices for sales in less than ton lots were somewhat higher than those in ton lots. Shipments of nitrate of soda were heaviest in June, more than 3,000 tons being sold in that month from Savannah alone.

For comparison with the above f. o. b. cash prices of distributors to farmers and merchants the following cash and credit prices for purchases from local dealers and fertilizer manufacturers are given. The delivered cash prices paid by seven farmers in the same territory ranged from $46 at Mount Pleasant and Neeses, S. C., to $48.50 at Dillon, S. C., the freight rate from Charleston to Dillon being $2.20 per ton. The delivered time or credit prices paid by 24 farmers in the same territory ranged from $48.25 at Sumter, S. C. (freight rate from Charleston $1.80), to $63.07 at Athens, Ga., the freight rate from Savannah to Athens being $2.57 per ton. Thirteen of the 24 purchasers on time obtained their nitrate of soda at prices ranging from $55.20 to $56.80 per ton. At Dillon, S. C., the credit price for one farmer was $56.15 and for another $60, thus showing a difference of $3.85 per ton between two credit prices in the same town. At Athens, Ga., one farmer paid $52.50 and another $63.07, both on time. The difference between the cash price of $48.50 at Dillon, S. C., mentioned above and the high credit price of $60 was $11.50 per ton, equivalent to a saving of about 20 per cent to the cash purchaser. At Neeses, S. C., a farmer paid $46 cash, while his neighbor who bought on time paid $56.

Acid phosphate.—Average prices of 16 per cent bulk acid phosphate f. o. b. Baltimore and Savannah and average prices of distributors by months for the same material, bagged and tagged, f. o. b. Norfolk, Charleston, and Savannah, for the period January to June, 1914, are presented in Table 50 below. It is estimated that the cost of bags, labor, and tags is about $1.50 per ton, so that this amount should be added to the bulk price before comparison is made with distributor's prices.

TABLE 50.—COMPARISON OF AVERAGE WHOLESALE PRICES OF 16 PER CENT BULK ACID PHOSPHATE PER TON, F. O. B. BALTIMORE AND SAVANNAH, WITH AVERAGE CASH PRICES OF DISTRIBUTORS TO MERCHANTS AND FARMERS F. O. B. NORFOLK, CHARLESTON, AND SAVANNAH, BY MONTHS, JANUARY TO JUNE, 1914.

Month.	Wholesale prices in bulk per ton.[2]		Average cash prices, bagged and tagged, to merchants and farmers.						
			Ton lots				Less than ton lots.		
			Va., N. C., S. C., Ga., and Ala.			Florida.[1]	Va., N. C., S. C., Ga., and Ala.		Florida.[1]
	F. o. b. Baltimore.	F. o. b. Savannah.	F. o. b. Norfolk.	F. o. b. Charleston.	F. o. b. Savannah.	F. o. b. Savannah.	F. o. b. Norfolk.	F. o. b. Savannah.	F. o. b. Savannah.
January	....	$6.36	$9.65	$8.50	$8.70	$11.19	$12.00	....	$11.73
February	$6.75	5.90	9.51	8.50	8.77	10.42	10.00	....	12.20
March	7.00	5.75	9.77	8.50	8.52	12.20	10.09	10.10	12.40
April	7.25	5.74	9.94	7.91	8.44	11.58	11.52	10.15	11.90
May	6.51	7.28	9.84	8.21	8.78	11.61	10.17	....	12.00
June	6.70	7.84	9.93	8.50	9.01	10.98	11.11	10.69	11.68

[1] The prices to merchants and farmers in Florida were tabulated separately because they were somewhat higher than those to merchants and farmers in Georgia and Alabama.

[2] $1.50 per ton should be added for cost of bags, tags, and bagging.

The wholesale prices of bulk acid phosphate at Savannah during the months of February, March, and April, 1914, were abnormally low, being considerably below the cost of production shown in Chapter IV (see p. 92). The distributor's prices for ton lots, bagged and tagged, at Savannah were not as low correspondingly, ranging from $8.44 in April to $9.01 in June. Deducting $1.50 a ton for bags, the labor of bagging and tags, they show a difference ranging from $1.37 in February to minus 33 cents in June. Distributor's prices at Charleston were slightly lower than those at Savannah, ranging from $7.91 in April to $8.50 in four other months, while those at Norfolk were nearly $1 a ton higher on the average. Prices for Florida deliveries were higher than for deliveries in the other States, ranging from $10.42 to $12.20 for ton lots and from $11.68 to $12.40 for less than ton lots. The latter price was more than double the wholesale bulk price at Savannah in the same month.

For comparison with the above cash prices, figures were obtained from a number of farmers for cash and credit purchases from local dealers and fertilizer manufacturers. Twenty different farmers in 10 localities who purchased for cash paid from $8 per ton at Jefferson, Ga., to $11 at Orangeburg and Bamberg, S. C. The freight rate from Charleston to Orangeburg was $1.65 and from Savannah to Bamberg $2 per ton. Fifteen of the 20 cash purchasers, however, paid from $10 to $11 a ton. The credit prices to 20 farmers ranged from $9 at Mount Pleasant, which is near Charleston, S. C., to $15.50 at Orangeburg, S. C. Five of the 20 received a time price of $13, and 8 paid prices ranging from $13.50 to $14.50. The following tabulation shows the low cash price and the high credit price per ton paid for acid phosphate by consumers at five points in South Carolina and the difference between these prices:

Town.	Low cash price.	High credit price.	Difference.
Sumter	$10.40	$12.00	$1.60
Neeses	10.25	13.50	3.25
Mount Pleasant	8.65	12.00	3.35
Dillon	10.20	14.25	4.05
Orangeburg	10.50	15.50	5.00

The difference between the low cash price and the high credit price for acid phosphate purchased from local dealers or fertilizer manufasturers ranged from $1.60 per ton at Sumter, S. C., to $5 per ton at Orangeburg, S. C. The cash price paid by one farmer at Orangeburg, S. C., was more than 32 per cent less than the credit price of his neighbor, who paid $15.50 per ton. Likewise, another farmer at Elberton, Ga., saved $4.55 per ton by paying cash, or 33 per-cent on the price of $14 paid by his neighbor who bought on time. At Neeses,

S. C., one cash purchaser saved $3.25 per ton, or 24 per cent, on the time price of $13.50 paid by his neighbor. Cash purchasers at Sumter saved 13 per cent, at Dillon, 28 per cent, and at Mount Pleasant, 28 per cent over their neighbors who bought on time, and who paid $12, $14.25, and $12, respectively.

Potash salts.—Wholesale prices and distributors' prices to merchants and farmers for kainit and muriate of potash are given in Tables 51 and 52 below.

TABLE 51.—COMPARISON OF WHOLESALE NET PRICES OF KAINIT, C. I. F. ATLANTIC PORTS, WITH AVERAGE CASH PRICES OF DISTRIBUTORS TO MERCHANTS AND FARMERS F. O. B. NORFOLK, CHARLESTON, AND SAVANNAH, BY MONTHS, JANUARY TO JUNE, 1914.

Month.	Net price c. i. f. Atlantic ports in bulk to fertilizer manufacturers per ton.[1]	Average cash prices, bagged and tagged, to merchants and farmers, in ton lots.			
		Va., N. C., S. C., Ga., and Ala.			Florida.[2]
		F. o. b. Norfolk.	F. o. b. Charleston.	F. o. b. Savannah.	F. o. b. Savannah.
January	$7.06	$9.75	$9.42	$9.94	$11.00
February	7.06	10.01	9.47	9.52	11.91
March	7.06	9.56	9.51	9.49	11.00
April	7.06	9.66	9.63	9.54	....
May	7.06	9.75	....	9.26	11.00
June	7.06	9.75	....	10.00	10.00

[1] Net prices to fertilizer manufacturers under contract with potash syndicate; $1.50 per ton should be added for bags, tags, and bagging.

[2] The prices to merchants and farmers in Florida were tabulated separately because they were somewhat higher than those to merchants and farmers in Georgia and Alabama.

TABLE 52.—COMPARISON OF WHOLESALE NET PRICES OF MURIATE OF POTASH, C. I. F. ATLANTIC PORTS, WITH AVERAGE CASH PRICES OF DISTRIBUTORS TO MERCHANTS AND FARMERS F. O. B. NORFOLK, CHARLESTON, AND SAVANNAH, BY MONTHS, JANUARY TO JUNE, 1914.

Month.	Net prices c. i. f. Atlantic ports to fertilizer manufacturers per ton.[1]	Average cash prices, bagged and tagged, to merchants and farmers.						
		Ton lots.				Less than ton lots.		
		Va., N. C., S. C., Ga., and Ala.			Florida.	Va., N. C., S. C., Ga., and Ala.		Florida.
		F. o. b Norfolk.	F. o. b. Charleston.	F. o. b. Savannah.	F. o. b. Savannah.[2]	F. o. b. Norfolk.	F. o. b. Savannah.	F. o. b. Savannah.
January	$33.21	$36.00	$36.00	$36.84	[3] $39.00	$36.89	....	$38.15
February	33.21	36.68	36.00	36.66	38.86	39.70	$39.33	39.29
March	33.21	36.31	36.13	37.15	....	38.54	40.05	38.91
April	33.21	36.25	....	37.53	....	38.75	40.02	40.00
May	33.21	36.88	....	36.41	....	37.87	40.00	39.66
June	33.21	37.13	....	36.19	....	38.67	38.91	38.48

[1] Net prices to fertilizer manufacturers under contract with potash syndicate.

[2] The ton prices to merchants and farmers in Florida were tabulated separately because they were somewhat higher than those to merchants and farmers in Georgia and Alabama.

[3] Represents one shipment only.

The net cash prices of kainit and muriate of potash c. i. f. Atlantic ports are those paid by fertilizer manufacturers who are parties to the five large contracts with the potash syndicate (see p. 155), and are less than what the distributors paid. The distributor's prices of kainit also include the cost of bags, bagging, and tags, which amounts to about $1.50 per ton. Deducting this amount from the distributor's prices, the margin over the syndicate prices for deliveries to all the States except Florida ranged from 86 cents at Charleston in January to $1.45 for Norfolk in February and $1.44 for Savannah in June. The margin for Florida deliveries was somewhat larger, as in the case of the other materials.

The margin of the distributor's f. o. b. price of muriate over the syndicate price for deliveries of ton lots to all the States except Florida ranged from $4.32 at Savannah to $2.79 at Norfolk and Charleston. The margin for Florida deliveries was somewhat larger.

The range of prices for kainit was from $9.26 in May f. o. b. Savannah to $10.01 in February f. o. b. Norfolk. Merchants and farmers in Florida, however, paid from $10 in June to $11.91 in February on shipments f. o. b. Savannah. The shipments in less than ton lots were not numerous enough to tabulate.

The prices for muriate of potash ranged from $36 per ton in January f. o. b. Norfolk and Charleston to $37.53 in April f. o. b. Savannah. On shipments to Florida the prices were $39 and $38.86 in January and February, respectively. In less than ton lots the prices ranged from $36.89 f. o. b. Norfolk to $40.05 f. o. b. Savannah.

In comparison with the distributor's prices presented above, 15 farmers in the same territory who purchased kainit from local dealers or fertilizer manufacturers for cash paid from $9.50 per ton at Mount Pleasant, near Charleston, S. C., to $14.50 at Marion, S. C., which takes a freight rate of $1.86 per ton from Wilmington, N. C., making the difference between the high and low cash prices $5. Twelve of the fifteen, however, paid prices ranging from $11 to $12 per ton. Fourteen farmers who bought on credit paid from $12 at Oswego, S. C., to $16 at Orangeburg, S. C., which takes a freight rate of $1.65 from Charleston. Three farmers paid $15 per ton, and seven paid prices ranging from $13 to $14.30 per ton.

The cash prices of local dealers or fertilizer manufacturers for muriate of potash to 6 farmers varied from $37 at Sumter to $43 at Athens and Lexington, Ga., while the credit prices to 12 farmers ranged from $42.60 at Lumberton, N. C., to $54 at Mount Pleasant, S. C. Four of the twelve paid $45 per ton each.

Cottonseed meal.—Cottonseed meal is not handled to any extent by the distributing concerns, it being available to farmers at the numerous cotton-oil mills scattered throughout the South. In some localities farmers often exchange cotton seed for meal.

The average monthly wholesale prices f. o. b. Georgia mills for prime meal in lots of 10 tons or more for the first six months of 1914 ranged from $25.61 per ton (low) in January to $26.89 (high) in February. (See p. 140.) For less than 10-ton lots the average monthly prices per ton f. o. b. Georgia mills ranged from $26.16 in May to $27.17 in April. In comparison with these prices, the cash prices paid by 10 farmers to local dealers, brokers, or oil mills for cottonseed meal ranged from $27.39 at Elberton, Ga., to $30 at Orangeburg and Mount Pleasant, S. C. Three paid $28 and three $29. Eight buying on credit paid from $27.50 at Orangeburg, S. C., to $35 at Elberton, Ga. The credit price to four farmers at as many different points was $32. At Orangeburg, S. C., one farmer secured cottonseed meal on credit for $27.50 per ton, while his neighbor had to pay $33. At Mullins, S. C., a farmers' organization purchased more than 100 tons for cash at prices ranging from $26 to $29 per ton. The members secured the meal at an advance of 50 cents per ton over these prices.

CHAPTER VIII.

THE PRODUCTION AND SALE OF MIXED FERTILIZERS.

Section 1. Introduction.

It is estimated that about 80 per cent of the fertilizers consumed in the United States are in the form of mixed goods containing two or three of the essential elements of commercial fertilizers.[1] The remainder consists of the simple materials which are sold to farmers who prefer to do their own mixing or who apply them in unmixed form to the soil.

The consumption of fertilizer is heaviest in the Southeastern States, comparatively little being sold in States west of the Mississippi, except in California. Georgia consumes the largest quantity, South Carolina, North Carolina, and Alabama being next in order. Table 53, taken from the American Fertilizer Handbook for 1915, shows the total tons consumed by 15 leading States for the years 1909 to 1914, inclusive. These figures are fairly accurate for States in the South having tonnage taxes, while for other States they are estimates based on the best information obtainable. The figures include materials sold to consumers as well as mixed goods. They are probably under rather than over the actual consumption.

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[1] This figure is based on the returns of bagged goods sold by 44 companies (including the 7 largest) which sold 4,570,361 tons out of the total estimated consumption of 6,759,809 in 1913. The classification of the reported sales and distribution of the total estimated consumption based on such sales are as follows:

Material.	Sales of 44 companies.	Per cent.	Consumption.
	Tons.		*Tons.*
Ammoniated goods	3,225,842	70.6	[a] 4,772,425
Alkaline (acid phosphate and potash mixtures)	436,770	9.6	[a] 648,942
Acid phosphate	472,995	10.3	[a] 696,260
Miscellaneous materials	434,754	9.5	[a] 642,182
Total	4,570,361	100.0	6,759,809

[a] Consumption estimated from proportion of total sales of 44 companies to estimated total consumption of all kinds of bagged goods.

The 44 companies handled more than 67 per cent of the total estimated consumption, leaving only 2,189,448 tons for the more than 750 manufacturers and manipulators not reporting, or an average of about 3,000 tons each. The ammoniated goods constituted 70.6 per cent; alkaline, 9.6 per cent; acid phosphate, 10.3 per cent; and miscellaneous materials, 9.5 per cent. The miscellaneous materials consist largely of potash salts and nitrate of soda.

TABLE 53.—ESTIMATED CONSUMPTION OF COMMERCIAL FERTILIZER IN THE UNITED STATES AND PER CENT OF TOTAL, BY STATES, 1909–1914.[1]

State.	1909		1910		1911	
	Net tons.	Per cent.	Net tons.	Per cent.	Net tons.	Per cent.
Georgia	807,832	16.5	1,022,048	17.8	1,202,722	19.0
South Carolina	758,363	15.5	975,039	17.0	1,048,806	16.6
North Carolina	512,716	10.5	630,909	11.0	711,380	11.2
Alabama	400,000	8.2	425,000	7.4	440,000	7.0
New York	325,000	6.6	375,000	6.5	400,000	6.3
Virginia	323,644	6.6	344,951	6.0	359,465	5.7
Pennsylvania	275,000	5.6	300,000	5.2	315,000	5.0
Florida	156,340	3.2	172,641	3.0	183,437	2.9
Indiana	134,064	2.7	151,856	2.7	179,839	2.9
Ohio	137,000	2.8	142,000	2.5	148,000	2.3
Maryland	142,000	2.9	148,000	2.6	158,000	2.5
Maine	100,000	2.0	125,000	2.2	140,000	2.2
New Jersey	110,000	2.2	125,000	2.2	135,000	2.1
Mississippi	139,884	2.9	132,776	2.3	148,237	2.3
Massachusetts	55,000	1.1	65,000	1.1	72,000	1.1
All other[2]	523,607	10.7	601,313	10.5	690,280	10.9
Total	4,900,450	100.0	5,736,533	100.0	6,332,166	100.0

State.	1912		1913		1914	
	Net tons.	Per cent.	Net tons.	Per cent.	Net tons.	Per cent.
Georgia	1,103,864	18.1	1,120,693	16.6	1,282,088	16.8
South Carolina	886,222	14.5	918,336	13.6	1,095,728	14.4
North Carolina	695,705	11.4	840,447	12.4	872,820	11.4
Alabama	452,215	7.4	474,730	7.0	[3]605,600	7.9
New York	425,000	7.0	460,000	6.8	490,000	6.4
Virginia	372,108	6.1	412,434	6.1	437,808	5.7
Pennsylvania	318,716	5.2	340,000	5.0	381,900	5.0
Florida	187,927	3.1	213,728	3.2	240,812	3.2
Indiana	143,678	2.3	193,899	2.9	219,000	2.9
Ohio	151,784	2.5	183,476	2.7	203,000	2.7
Maryland	160,000	2.6	169,000	2.5	183,350	2.4
Maine	150,000	2.5	160,000	2.4	168,000	2.2
New Jersey	140,000	2.3	156,661	2.3	155,414	2.0
Mississippi	119,710	2.0	128,056	1.9	127,400	1.7
Massachusetts	75,000	1.2	125,000	1.8	150,000	2.0
All other[2]	723,397	11.8	863,355	12.8	1,013,519	13.3
Total	6,105,326	100.0	6,759,809	100.0	7,626,439	100.0

[1] Taken from American Fertilizer Handbook, 1915, p. 102.
[2] 33 States.
[3] Reported to the Federal Trade Commission by Alabama officials.

The total estimated consumption of fertilizers showed an increase for the six years, 1909 to 1914, inclusive, of nearly 56 per cent. There was an increase in each year over the previous year except 1912, when there was a decrease of 3.6 per cent from the preceding year. The increase in Georgia for the six-year period, 1909 to 1914, was nearly 59 per cent. In South Carolina, the next largest consuming State, the increase of 1911 over 1909 was about 38 per cent, while the 1913 increase over 1909 was only about 20 per cent. In 1914 the consumption was nearly 45 per cent more than in 1909. The consumption of commercial fertilizers in four States—Georgia, South Carolina, North Carolina, and Alabama—constituted about 50 per cent of the total for the United States in each of the six years covered by the table. In 1911 it was 53.7 per cent and in 1913, 49.6 per cent; the other years ranged between these figures. All of the remaining States given in the table show an increase in consumption in 1914 over 1909 with the exception of Mississippi. The increase for all the other States, or those consuming less than 100,000 tons annually, was more than 93 per cent for the six-year period. These 33 other States consumed in each year less than the single State of South Carolina.

Section 2. Principal fertilizer manufacturers.

There are approximately 800 concerns in the United States engaged in the mixed-fertilizer business, excluding those which are subsidiary to or affiliated with other companies. The sales of 2 of these concerns in 1913 exceeded 1,000,000 tons each, and the sales of 5 other concerns exceeded 200,000 tons each. In addition to these 7 large concerns, there are 3 others whose output in 1913 exceeded 75,000 tons but was less than 100,000 tons, and perhaps 10 others whose annual output was about 50,000 tons. None of the remaining concerns, about 780 in number, produces annually as much as 50,000 tons. Table 54 shows the capitalization and bonded indebtedness of 6 of the 7 largest companies. The Swift fertilizer business is owned by Swift & Co., of Illinois, and the capitalization of the fertilizer branch can not be shown separately.

TABLE 54.—CAPITAL STOCK OUTSTANDING AND FUNDED INDEBTEDNESS OF PRINCIPAL FERTILIZER MANUFACTURERS IN 1914.

Company.	Capital stock issued.		Funded indebtedness.	Total.
	Common.	Preferred.		
Virginia-Carolina Chemical Co	$27,984,400	$20,000,000	[1] $18,500,000	$66,484,400
The American Agricultural Chemical Co [2]	18,430,900	27,558,200	16,453,000	62,442,100
International Agricultural Corporation	7,303,500	13,055,500	12,418,800	32,777,800
Armour Fertilizer Works [3]	1,000,000			1,000,000
F. S. Royster Guano Co	1,000,000	1,500,000		2,500,000
Baugh & Sons companies [4]	2,000,000			2,000,000

[1] Includes $5,000,000 6 per cent convertibles offered in May, 1914.

[2] As of April 15, 1915.

[3] All owned by stockholders of Armour & Co.

[4] Includes Baugh & Sons Co., of Philadelphia; Baugh Chemical Co. of Baltimore County; and Baugh & Sons Co. of Baltimore City.

A further indication of the importance of the seven largest companies is shown by their sales during the fiscal year 1913 given in Table 55. The companies are shown in the order of total sales. The combined sales amounted to 3,934,523 net tons, or more than 58 per cent of the total estimated consumption shown in Table 53.

Based on sales of bagged goods alone, The American Agricultural Chemical Co. ranks first instead of second, and the International Agricultural Corporation, excluding its forty affiliated companies from which data could not be obtained, seventh instead of fourth.

TABLE 55.—FERTILIZER SOLD IN BAGS AND IN BULK BY THE SEVEN LARGEST COMPANIES FOR THE SEASON OF 1913.

Company.	Bagged goods.					Bulk goods.			Total all sales.
	Ammoniated.	Alkaline.	Acid phosphate.	Miscellaneous materials.	Total.	Acid phosphate.	Miscellaneous materials.	Total.	
	N. tons.	*N. tons.*	*N. tons.*	*N. tons.*	*N. tons.*	*N. tons.*	*N. tons.*	*N. tons.*	*N. tons.*
Virginia-Carolina Chemical Co.[1]	699,761	98,887	133,864	101,341	1,033,853	131,695	26,810	158,505	1,192,358
The American Agricultural Chemical Co.	750,866	141,664	69,212	92,225	1,053,967	71,624	....	71,624	1,125,591
Armour Fertilizer Works	330,592	45,239	48,082	63,952	487,865	42,993	18,121	61,114	548,979
International Agricultural Corporation[2]	91,684	10,483	11,553	18,541	132,261	176,541	18,567	195,108	327,369
F. S. Royster Guano Co.	185,060	18,978	20,636	18,369	243,043	27,483	3,913	31,396	274,439
Swift & Co	158,874	11,033	24,272	26,479	220,658	25,849	....	25,849	246,507
Baugh & Sons companies[3]	106,671	13,372	14,684	22,701	157,428	56,021	5,831	61,852	219,280
Total	2,323,508	339,656	322,303	343,608	3,329,075	532,206	73,242	605,448	3,934,523

[1] Includes Southern Cotton Oil Co. and most of affiliated companies.

[2] Includes 100 per cent companies, but no affiliated companies.

[3] Includes Baugh & Sons Co. of Philadelphia; Baugh Chemical Co. of Baltimore County; and Baugh & Sons Co. of Baltimore City.

The greater part of the total sales of bulk goods shown in the table, amounting to 605,448 tons, went to other manufacturers and mixers, while the total sales of bagged goods, amounting to 3,329,075 tons, went mainly to dealers and farmers. Of these total sales of bagged goods, 2,323,508 tons, or 69.8 per cent, were ammoniated; 339,656 tons, or 10.2 per cent, were so-called alkaline, i. e., mixtures of acid phosphate and potash; 322,303 tons, or 9.7 per cent, were acid phosphate; and 343,608 tons, or 10.3 per cent, were miscellaneous materials, such as nitrate of soda, potash salts, tankage, etc. Of the total sales of bulk goods, acid phosphate constituted 87.9 per cent.

The quantity of certain high-grade materials used in 1913 by the seven large companies in the manufacture of ammoniated and alkaline mixtures is shown in Table 56 following:

TABLE 56.—PRINCIPAL HIGH-GRADE FERTILIZER MATERIALS USED IN MIXED GOODS BY THE SEVEN LARGEST COMPANIES DURING SEASON OF 1913.

Company.	Nitrates and ammoniates.						
	Nitrate of soda.	Sulphate of ammonia.	Cyanamid.	High-grade tankage.	Dried blood.	Dried fish scrap.	Cotton-seed meal.
	Net tons.	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*
Virginia-Carolina Chemical Co.[1]	23,782	21,109	258	11,158	4,007	16,269	52,571
The American Agricultural Chemical Co.	14,511	24,642	5,737	61,926	1,103	7,852	3,862
Armour Fertilizer Works[2]	11,120	11,164	....	47,800	4,327	3,538	5,984
International Agricultural Corporation[3]	2,261	742	834	7,358	358	1,457	3,886
F. S. Royster Guano Co.	1,418	6,555	....	3,507	188	3,367	2,125
Swift & Co	1,485	3,910	110	15,225	6,121	100	3,175
Baugh & Sons companies[4]	576	7,288	....	14,066	212	994	....
Total	55,153	75,410	6,939	161,040	16,316	33,577	71,603

[1] Includes Southern Cotton Oil Co. and most of affiliated companies.

[2] Does not include figures for Los Angeles factory.

[3] Includes 100 per cent companies, but no affiliated companies.

[4] Includes Baugh & Sons Co. of Philadelphia; Baugh Chemical Co. of Baltimore County; and Baugh & Sons Co. of Baltimore City.

TABLE 56.—PRINCIPAL HIGH-GRADE FERTILIZER MATERIALS USED IN MIXED GOODS BY THE SEVEN LARGEST COMPANIES DURING SEASON OF 1913—Continued.

Company.	Acid phosphate.	Potash salts.				
		Muriate.	Sulphate.	Manure salts.	Kainit.	Hartsalz.
	Net tons.	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*	*Net tons.*
Virginia-Carolina Chemical Co.[1]	319,882	21,973	7,006	2,765	81,708	219
The American Agricultural Chemical Co	359,381	32,565	4,581	41,451	40,314	....
Armour Fertilizer Works[2]	260,032	16,129	5,444	21,342	36,953	4,110
International Agricultural Corporation[3]	68,087	6,106	490	1,065	810	3,577
F. S. Royster Guano Co	127,081	6,081	94	16,088	2,241	....
Swift & Co	107,688	3,092	1,186	17,802	1,233	750
Baugh & Sons companies[4]	43,545	7,692	763	5,096	8,515	635
Total	1,285,696	93,638	19,564	105,609	171,774	9,291

[1] Includes Southern Cotton Oil Co. and most of affiliated companies.

[2] Does not include figures for Los Angeles factory.

[3] Includes 100 per cent companies, but no affiliated companies.

[4] Includes Baugh & Sons Co. of Philadelphia; Baugh Chemical Co. of Baltimore County; and Baugh & Sons Co. of Baltimore City.

As shown by the above table, the seven companies used 55,153 tons of nitrate of soda, 75,410 tons of sulphate of ammonia, and 6,939 tons of cyanamid, making the total quantity of inorganic nitrogenous materials used 137,502 tons. The total quantity of high-grade organic ammoniates used was 282,536 tons, of which 161,040 tons were high-grade tankage, 16,316 tons dried blood, 33,577 tons dried fish scrap, and 71,603 tons cottonseed meal. It is estimated that the total of these organic and inorganic materials, 420,038 tons, is equivalent to about 5,800,000 units of ammonia, of which the inorganics furnished more than 3,000,000 units. This total would be sufficient to supply an ammonia content of about 2.5 per cent in all the ammoniated goods sold by the 7 companies. It is probable, however, that the average ammonia content of the complete goods was somewhat higher, inasmuch as considerable quantities of low-grade ammoniates, not accounted for in the above table, are used in making the total tonnage of complete fertilizers.

The relation of the quantity of nitrate of soda to sulphate of ammonia is impressive in that only 55,153 tons or 854,872 units of nitrogen of the former were used, as compared with 75,410 tons or 1,545,905 units of nitrogen of the latter. In other words, on the basis of nitrogen content the sulphate of ammonia used by these 7 companies in complete goods exceeded nitrate of soda by more than 691,000 units. On the other hand, 17 smaller companies reporting to the Commission used 14,756 tons of nitrate of soda, or 228,718 units of nitrogen, and 10,763 tons of sulphate of ammonia or 220,642 units of nitrogen in 434,561 tons of ammoniated goods sold in 1913 season. For these smaller companies the nitrogen content in nitrate of soda exceeded sulphate of ammonia by more than 8,000 units.

The American Agricultural Chemical Co. and the Armour Fertilizer Works used 61,926 and 47,800 tons, respectively, of high-grade tankage, as compared with only 11,158 tons for the Virginia-Carolina Chemical Co. On the other hand, the Virginia-Carolina Chemical Co. used very large quantities of cottonseed meal and dried fish scrap, as compared with the other large companies, one of which used no cottonseed meal at all in 1913. This difference in the consumption of organic ammoniates is due to geographical location of plants. The factories of the Virginia-Carolina Chemical Co. are located for the most part in or near the cotton-growing States, while those of The American Agricultural Chemical Co. are mostly in territory farther north. Furthermore, both The American Agricultural Chemical Co. and the Armour Fertilizer Works produce a part of the tankage they consume, and the Virginia-Carolina Chemical Co. gets a considerable portion of its cottonseed meal from its subsidiary, the Southern Cotton Oil Co.

The estimated proportion of the total estimated consumption of various nitrogenous fertilizer materials used by the seven large companies is shown in Table 57 below. The estimated consumption of nitrate of soda for fertilizer purposes is based on 40 per cent of the imports (649,168 tons) for the fiscal year 1913 (see p. 29). The estimated consumption of sulphate of ammonia is based on 90 per cent of the domestic shipments plus the total imports for the fiscal year 1913, while in the case of cyanamid the sales of the American Cyanamid Co. for the fiscal year ending March 31, 1913, are used as a basis. (See p. 35.) The total consumption of high-grade tankage and dried blood is based on the estimated domestic production from the slaughter of meat animals at packing houses available for fertilizer purposes in the fiscal year 1913, as shown on page 73, while that of dried fish scrap is the 1912 production (see p. 82), and that of cottonseed meal is the estimated quantity of the 1912 output used for fertilizer purposes. (See p. 58.) Although the figures for fish scrap and cottonseed meal are for the calendar year 1912, they are representative of the fiscal year figures, since the output of these materials was consumed largely in the fiscal year 1913.

TABLE 57.—ESTIMATED PROPORTION OF HIGH-GRADE NITROGENOUS MATERIALS CONSUMED IN MIXED GOODS BY SEVEN LARGEST COMPANIES, FISCAL YEAR 1913.

Material.	Total estimated consumption.	Consumption by seven large companies.	Per cent of total.
	Net tons.	*Net tons.*	
Nitrate of soda	260,000	55,153	21.2
Sulphate of ammonia	130,000	75,410	58.0
Cyanamid	[1] 15,488	6,939	44.8
High-grade tankage	210,000	161,040	76.7
Dried blood	41,772	16,316	39.1
Dried fish scrap	[2] 50,885	33,577	66.0
Cottonseed-meal	[3] 666,000	71,603	10.8

[1] American Cyanamid Co.'s sales for fiscal year ending Mar. 31, 1913.
[2] 1912 production.
[3] Estimated part of 1912 production used for fertilizer purposes.

The proportion of the fertilizer business, as indicated by tag-tax receipts for the 1914 season, done by the 7 large companies, including their subsidiaries and affiliated companies, in the States of North Carolina, South Carolina, Georgia, and Alabama, the four largest consuming States, is shown in Table 58:

TABLE 58.—FERTILIZER SALES AS INDICATED BY TAG-TAX RECEIPTS OF THE SEVEN LARGE COMPANIES IN FOUR SOUTHERN STATES, TOTAL SALES, AND PERCENTAGE OF SUCH SALES TO TOTAL, 1914 SEASON.

Companies.	Georgia.[1]		South Carolina.		North Carolina.		Alabama.	
	Tonnage.	Per cent of total.	Tonnage.	Per cent of total.	Tonnage.	Per cent of total.	Tonnage.	Per cent of total.
Virginia-Carolina Chemical Co.—total	217,866	16.8	212,493	20.4	266,519	30.4	112,150	18.5
Virginia-Carolina Chemical Co. proper	120,800	9.3	114,350	11.0	225,700	25.8	49,100	8.1
Subsidiaries	61,266	4.7	67,693	6.5	27,325	3.1	38,000	6.3
Affiliated companies	35,800	2.8	30,450	2.9	13,494	1.5	25,050	4.1
The American Agricultural Chemical Co.—total	39,600	3.1	132,450	12.7	73,525	8.4	32,300	5.3
The American Agricultural Chemical Co. proper	31,100	2.4	69,100	6.6	46,600	5.3	32,300	5.3
Subsidiaries	8,500	.7	63,350	6.1	26,925	3.1		
Armour Fertilizer Works—total	97,320	7.5	23,500	2.2	37,200	4.3	26,150	4.3
Armour Fertilizer Works proper	60,000	4.6	19,500	1.8	36,900	4.2	1,050	.2
Subsidiaries	37,320	2.9	4,000	.4	300	.1	[2] 25,100	4.1
International Agricultural Corporation—total	155,022	12.0	89,900	8.6	5,400	.6	57,250	9.5
International Agricultural Corporation proper	13,600	1.0	23,060	2.2			36,550	6.0
Subsidiaries	9,700	.8	1,500	.1			1,500	.2
Affiliated companies	131,722	10.2	65,340	6.3	5,400	.6	20,200	3.3
F. S. Royster Guano Co.—total	30,850	2.4	42,300	4.1	78,875	9.0	26,000	4.3
F. S. Royster Guano Co. proper	26,850	2.1	42,300	4.1	78,875	9.0	25,500	4.2
Subsidiaries	4,000	.3					500	.1
Swift & Co.	60,050	4.7	31,250	3.0	27,200	3.1	8,350	1.4
Baugh & Sons Co.	2,800	.2			21,650	2.5		
Total tonnage, 7 large concerns	603,508	46.7	531,893	51.0	510,369	58.3	262,200	43.3
Total tonnage, other concerns	689,161	53.3	510,989	49.0	364,659	41.7	343,400	56.7
Grand total	1,292,669	100.0	[3] 1,042,882	100.0	[3] 875,028	100.0	605,600	100.0

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[1] The figures for Georgia are for period Oct. 1, 1913, to Dec. 31, 1914. Fiscal year changed to correspond with calendar year.

[2] Includes 3,450 tons sold by the Boaz Fertilizer Co., an affiliated company.

[3] The figures for South Carolina and North Carolina, which were compiled from reports of State officials, differ slightly from the figures shown in Table 53 above (see p. 171), which were taken from the 1915 American Fertilizer Hand Book.

The seven large companies handled 58.3 per cent of the total sales of fertilizers in North Carolina, 51 per cent in South Carolina, 46.7 per cent in Georgia, and 43.3 per cent in Alabama. The sales of the Virginia-Carolina Chemical Co., including its subsidiaries and affiliated companies, were largest in each of the States, being 30.4 per cent of the total in North Carolina, 20.4 in South Carolina, 18.5 in Alabama, and 16.8 in Georgia. Ranking the other companies in order of importance, the International Agricultural Corporation was second in Georgia and Alabama, third in South Carolina, and seventh in North Carolina. The American Agricultural Chemical Co. was second in South Carolina, third in North Carolina and Alabama, and fifth in Georgia. The Armour Fertilizer Works was third in Georgia, fourth in North Carolina, fourth in Alabama, and sixth in South Carolina. The F. S. Royster Guano Co. was second in North Carolina, fourth in South Carolina, fifth in Alabama, and sixth in Georgia. Swift & Co. was fourth in Georgia, fifth in South Carolina, and North Carolina, and sixth in Alabama. Baugh & Sons Co. ranked sixth in North Carolina and seventh in Georgia, selling none in Alabama and South Carolina.

Section 3. Fertilizer plants in the United States.

There are two processes of preparing mixed goods: (1) wet mixing and (2) dry mixing. The former is possible of accomplishment only by plants equipped for the manufacture of acid phosphate. As practiced to-day it consists in adding the low-grade nitrogenous materials used in making base goods to the wet mixture of ground phosphate rock and sulphuric acid before it is dumped into the den or upon the stock pile. Frequently the acid-phosphate mixture is removed from the den or pile while it is still hot and some of the organic ammoniates, such as tankage and fish scrap, are added to it. The free acid contained and the heat serve to increase the availability and to improve the mechanical condition of these materials. Such materials as nitrate of soda, cottonseed meal, and potash salts are not added to the acid-phosphate mixture until it is thoroughly dried out and cooled.

The dry mixer purchases its acid phosphate and other materials and manipulates them in dry form. It performs only the last operation of the wet mixer; its mechanical equipment consists mainly of a mixing machine.

There were approximately 1,200 fertilizer plants in the United States in 1914, more than 78 per cent of which were dry mixers. The classification of these plants by kind and by States is shown in Table

59 below. The figures were compiled from information obtained directly from the fertilizer companies or from the American Fertilizer Handbook for 1914 and the Commercial Fertilizer Yearbook for 1914. It is possible that some small dry mixers are not included.

TABLE 59.—NUMBER AND CHARACTER OF FERTILIZER PLANTS IN OPERATION, BY STATES, 1914.

State.	Complete.	Complete except acid chambers.	Dry mixers.		Total.
			Connected with cotton-oil mills.	Other.	
Georgia	31	23	85	233	372
Alabama	13	7	40	75	135
South Carolina	16	9	42	42	109
North Carolina	11	5	35	23	74
Pennsylvania	6	9		33	48
Maryland	7	11		27	45
Virginia	9	5		30	44
Ohio	6	10		18	34
Texas	1		19	14	34
California	4	7		17	28
Mississippi	5	3	12	6	26
New Jersey	6	3		16	25
Florida	5	4	2	10	21
New York	1	2		17	20
Illinois		7		10	17
Connecticut		1		16	17
Indiana	3	1		13	17
Louisiana	5	2	8	2	17
Arkansas		1	11	3	15
Massachusetts	1	4		8	13
Tennessee	3	3	1	5	12
Maine		1		8	9
Delaware				8	8
Kentucky	1			6	7
Michigan	1			4	5
Missouri	1	1		3	5
Washington				5	5
Other States [1]		1		27	28
Total	136	120	255	679	1,190

[1] Kansas and Oregon, 4 plants each; Wisconsin and West Virginia, 3 plants each; Colorado, Iowa, Nebraska, New Hampshire, and Rhode Island, 2 plants each; Oklahoma, Minnesota, Montana, and Vermont, 1 plant each.

Of the 256 wet mixers shown in the table, 136 are equipped with lead chambers for making sulphuric acid and 120 are equipped with machinery for the manufacture of acid phosphate. Of the 934 dry mixers, 255 are connected with cotton-oil mills in the Southern States. More than one-half of all the fertilizer plants in the United States are located in four Southern States. Georgia has 372, Alabama 135, South Carolina 109, and North Carolina 74.

The number of each class of fertilizer plants owned by the seven largest companies, including their subsidiary and affiliated companies, as compared with the total number in the United States, is shown in Table 60 below:

TABLE 60.—NUMBER OF PLANTS IN THE UNITED STATES OPERATED BY SEVEN LARGEST FERTILIZER COMPANIES,[1] BY CLASSES, TOTALS, AND PERCENTAGES, 1914.

Company.	All plants.		Wet mixers.				Dry mixers.			
	Total.	Per cent of total.	With acid chambers.	Without acid chambers.	Total.	Per cent of total.	Connected with cotton oil mills.	Not connected with cotton oil mills.	Total.	Per cent of total.
Virginia-Carolina Chemical Co	135	11.3	37	4	41	16.0	52	42	94	10.1
The American Agricultural Chemical Co.	29	2.4	18	6	24	9.4	......	5	5	.5
International Agricultural Corporation	63	5.3	......	19	19	7.4	......	44	44	4.7
Armour Fertilizer Works	41	3.4	7	7	14	5.5	1	26	27	2.9
Swift & Co	19	1.6	2	6	8	3.1	......	11	11	1.2
Royster Guano Co., F. S	9	.8	5	......	5	1.9	......	4	4	.4
Baugh & Sons Co	3	.3	2	......	2	.8	......	1	1	.1
Total, large concerns	299	25.1	71	42	113	44.1	53	133	186	19.9
Total, other concerns	891	74.9	65	78	143	55.9	202	546	748	80.1
Grand total	1,190	100.0	136	120	256	100.0	255	679	934	100.0

[1] Including subsidiary and affiliated companies.

Of the total number of fertilizer plants shown in the above table, 299, or about 25 per cent, are operated by the 7 large corporations, including their subsidiaries and affiliated companies. The Virginia-Carolina Chemical Co. has 135 plants, 94 of which are dry mixers. The International Agricultural Corporation has 63 plants, of which 44 are dry mixers, and The American Agricultural Chemical Co. has 29 plants, only 5 of which are dry mixers. The 7 large concerns together have more than 44 per cent of the wet mixers and only about 20 per cent of the dry mixers. The distribution of these plants by States is shown in the following sections of this chapter.

Section 4. Operation of controlled companies as independents.

A feature of the mixed-fertilizer industry, as shown in the following sections, is that the larger companies usually have various subsidiaries and affiliated companies engaged in manufacturing and selling fertilizers rather than conducting all of their operations under one company. Heretofore these controlled companies have been operated, as a rule, without disclosing this relationship to the public. The main purpose of such practice has been to secure the services of a larger number of local dealers for the sale of goods in a given locality. Where there are several dealers in a town each one desires to handle a line of goods not handled by the others. If all of the business of a fertilizer company were done in its own name, it would have, generally speaking, only one representative in a town, while by means of subsidiaries it may have all the dealers as representatives. It is claimed that several representatives, each pushing particular brands, secure more business than one representative handling all the brands of a company, and also that where sales are made through several representatives rather than through one, the credit risks are distributed. Another reason is that a company, prior to its acquisition by a large company, may have acquired a reputation which makes the use of its name very valuable. In some cases large sums have been paid for the brands and good will of acquired companies. A third reason which affects two or three of the largest companies is that the laws of some States require a qualifying tax based upon the total authorized capital stock, which is onerous for a corporation with a large capitalization unless it does an important business in the State. In States where such laws exist the general practice of a large concern is to qualify one of its small subsidiaries. For example, in Michigan the Virginia-Carolina Chemical Co. at one time qualified the Rasin-Monumental Co., of Baltimore, and in Ohio The American Agricultural Chemical Co. qualified its subsidiary, The American Agricultural Chemical Co. of Delaware, with a capitalization of $5,000.

A common form of subsidiary in the fertilizer industry is the selling company which has no plant, but sells goods put up for it by the controlling company. The American Agricultural Chemical Co. has 17 of these concerns; Virginia-Carolina Chemical Co., 6; International Agricultural Corporation, 3; Armour Fertilizer Works, 6; and F. S. Royster Guano Co., 4. Several of the smaller concerns also have one or more of them. The Read Phosphate Co., next in importance to the seven large companies, has 4, the Federal Chemical Co. has 3, The Jarecki Chemical Co. 3, and the Consolidated Rendering Co. 5.

Three of the large fertilizer companies—the Virginia-Carolina Chemical Co., Armour Fertilizer Works, and the International Agricultural Corporation—have followed the policy of acquiring an interest in a large number of small concerns operating dry-mixing plants. One purpose of acquiring such concerns has been to obtain an outlet for the surplus acid phosphate produced. Another reason has been to give them a local character, so that they might secure such business as the large companies could not get. The International Agricultural Corporation several years ago organized or acquired 40 such companies in order to dispose of its large surplus of acid phosphate which was produced to make use of the sulphuric acid purchased from the two Tennessee copper companies. The company also entered into profit-sharing contracts with a number of concerns for the same purpose.

The Virginia-Carolina Chemical Co. claims that the acquisition by the International Agricultural Corporation of these companies forced it to do the same thing. The names of dry mixers which it acquired are shown in the chart facing page 184. Not all of these affiliated dry mixers have been profitable. In some cases persons organizing them, who were also merchants, sold themselves the output at the lowest prices and resold to consumers, thus taking all the profit as middlemen. Contracts with these affiliated companies now provide that the Virginia-Carolina Chemical Co. shall have the right to audit the books at any time and pass upon their purchases.

The Armour Fertilizer Works also claims that the actitvities of the International Agricultural Corporation in acquiring numerous local dry-mixing concerns caused it to organize the various Georgia dry mixers shown below (see p. 200) in order to protect itself against any changes in the industry that might result from the movement. These companies, it is claimed, have not been a financial success and are in process of dissolution.

An objectionable feature of the operation of controlled companies has been the failure to disclose their identity to the public. In most cases there has been nothing on the letterheads, contracts, advertising matter, and bags of such companies to show by whom they were controlled. The farmer, in particular, has had no means of knowing what company he was actually patronizing. As a result the larger fertilizer manufacturers have been able to divert to themselves, to the detriment of their competitors, considerable business which they would not otherwise have secured. The selling companies have frequently aided the deception of the farmer by advertising as manufacturers, sometimes giving the capacity of their plants when they had none. In some cases they have given as addresses post-office boxes or a second entrance to the office building of the controlling company in order to conceal their connection with it. In a number of cases selling companies have been aggressive in price cutting, until their identity was discovered by competitors. Where price reductions are deemed necessary in order to dispose of their output, fertilizer manufacturers prefer to cut on their less well-known lines.

As shown in the following sections this objectionable feature of the fertilizer business has been largely eliminated by the voluntary action of the companies themselves, which hereafter will mark their letterheads, contracts, advertising matter, and bags in such a way that their corporate connection will be known by all who have dealings with them.

Section 5. Virginia-Carolina Chemical Co.

Organization and capitalization.—The Virginia-Carolina Chemical Co., in point of output, is the most important of the large fertilizer manufacturers.

It was organized September 12, 1895, under the laws of New Jersey. The original authorized capital stock of $6,500,000 has been increased from time to time until the present outstanding stock consists of $27,984,400 common and $20,000,000 preferred. The bonded indebtedness of the company consists of $13,500,000 (May 31, 1914) first mortgage 15-year 5 per cent bonds dated November 2, 1908, and $5,000,000 10-year 6 per cent gold debentures convertible into preferred stock at the rate of $110 of debentures for $100 of preferred.

Good-will account.—At the organization of the Virginia-Carolina Chemical Co. $3,348,900 was allowed for good will, brands, trademarks, etc., which represented the difference between the capitalization of the combined earnings of the constituent companies at 8 per cent for an average period of three years and the value of the property and cash turned in. This was approximately 50 per cent of the original capital stock issued. This good-will item has since been carried on the books of the company, but has not been shown separately on the balance sheets sent to stockholders since 1903. As a matter of fact, the good-will item has been considerably increased since the organization of the company, due principally to premiums paid in acquiring the stock of some of the subsidiaries, particularly the Southern Cotton Oil Co. and the Charleston (S. C.) Mining & Manufacturing Co. A recent reappraisement of some of the properties of the company shows some increases above the book values at which they are carried on the books. The phosphate holdings have also increased somewhat in value, but are still carried on the books at their original cost.

Companies acquired.—The Virginia-Carolina Chemical Co., prior to May, 24, 1902, acquired something like 39 fertilizer manufacturing concerns, as shown by the listing statement, dated March 13, 1901, filed with the New York Stock Exchange, and an additional list of five companies located in Alabama, appearing in an article published by the Commercial and Financial Chronicle of May 24, 1902. Ten of these plants were located at Charleston, S. C. The following is a list of the companies acquired, together with the location of plants:

Alabama Fertilizer Co., Montgomery, Ala.
Albany Fertilizer Factory, Albany, Ga.
Allison & Addison, Richmond, Va.
[1] American Fertilizing Co., Norfolk, Va.
Americus Guano Factory, Americus, Ga.
Ashley Phosphate Factory, Charleston, S. C.
Atlanta Guano Co., Atlanta, Ga.
Atlantic Factory, Charleston, S. C.
Atlantic & Virginia Fertilizing Co., Richmond, Va.
Baldwin Fertilizer Co., Port Royal, S. C., and Savannah, Ga.
Berkeley Phosphate Co., Charleston, S. C.
Blacksburg Factory, Blacksburg, S. C.
[1] Bryant Fertilizer Co., Alexandria, Va.

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[1] Active in 1915.

Chicora Fertilizer Co., Charleston, S. C.
Columbia Phosphate Factory, Columbia, S. C.
Commercial Guano Co., Columbus and Savannah, Ga.
Comer Hull & Co., Savannah, Ga.
[1] Coweta Fertilizer Co., Newnan, Ga.
Davie & Whittle, Petersburg, Va.
Durham Fertilizer Co., Durham, N. C.
Edisto Phosphate Co., The, Charleston, S. C.
[1] Georgia Chemical Works, Pon Pon, S. C., and Augusta, Ga.
Globe Phosphate Co., Columbia, S. C.
Greenville Fertilizer Factory, Greenville, S. C.
Imperial Fertilizer Co., Charleston, S. C.
Mobile Phosphate Co., Mobile, Ala.
Montgomery Fertilizer Co., Montgomery, Ala.
[1] Navassa Guano Co., Wilmington, N. C.
Norfolk & Carolina Chemical Co., Norfolk, Va.
Opelika Chemical Co., Opelika, Ala.
Pacific Chemical Co., Dothan, Ala.
[1] Pee Dee Cotton Seed Oil & Fertilizer Co., Darlington, S. C. (one-half interest).
Powers-Gibbs & Co., Wilmington, N. C.
[1] Rasin-Monumental Co., Baltimore, Md.
Richmond Chemical Works, Richmond, Va.
Rome Guano Co., Rome, Ga.
Scott, George W., Atlanta, Ga.
Southern Fertilizer Co., Cordele, Ga.
Southern Phosphate Works, Macon, Ga.
Standard Fertilizer Manufacturing Co., Charleston, S. C.
Stono Phosphate Co., Charleston, S. C.
Tinsley & Co., James G. (brands and good will only), Richmond, Va.
Travers & Co., S. W. (brands and good will only), Richmond, Va.
Walton Guano Co., Social Circle, Ga.
Wando Phosphate Co., Charleston, S. C.
Wappoo Factory, Charleston, S. C.

In addition to these fertilizer concerns, a partial or complete interest was acquired in several other companies, especially the Southern Cotton Oil Co. and the Charleston (S. C.) Mining & Refining Co. Since 1902 a number of other fertilizer companies have been taken over and several new plants have been built. One of the latest additions is the Consumers' Chemical Corporation, which was organized in 1913. It has a large wet mixing or acidulating plant at Carteret, N. J., which has a rated capacity of 50,000 tons of bagged goods. The Virginia-Carolina Chemical Co. owns all of the common stock outstanding, amounting to $100,000. The preferred stock of $500,000 is held by the public. There is no bonded indebtedness.

The Virginia-Carolina Chemical Co. in 1914 owned all the stock of 6 subsidiary fertilizer manufacturing companies and 6 selling companies. It also owned a controlling interest in 21 other concerns engaged in the manufacture and sale of fertilizers. The names of these subsidiary and affiliated companies, together with the location and character of the fertilizer plants operated by them and by the parent company, are shown by the chart of corporate organization facing this page.[1]

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[1] Active in 1915.

Identification of companies.—The Virginia-Carolina Chemical Co. has voluntarily agreed to identify all of the companies in which it has a 100 per cent control by using the words "Subsidiary of Virginia-Carolina Chemical Co." on their letterheads, advertising matter, contracts, and bags. In the case of the Southern Cotton Oil Co., these words will appear upon the bags only, since its fertilizer business is only a side line. There are 14 such subsidiary companies, i. e.:

Manufacturing and selling fertilizers:

Southern Cotton Oil Co., New York, N. Y.
Maysville Guano Co., Maysville, Ga.
Home Guano Co., Wadley, Ga.
Rasin-Monumental Co., Baltimore, Md.
Georgia Chemical Works, Augusta, Ga.
Navassa Guano Co., Wilmington, N. C.
Birmingham Fertilizer Co., Birmingham, Ala.
Bryant Fertilizer Co., Alexandria, Va.

Selling fertilizers only:

Peruvian Guano Corporation, Charleston, S. C.
Coweta Fertilizer Co., Atlanta, Ga.
Craven Chemical Co., New Bern, N. C.
American Fertilizing Co., Norfolk, Va.
Union Guano Co., Winston-Salem, N. C.
Rome Chemical Works, Atlanta, Ga.

The Virginia-Carolina Chemical Co. has also voluntarily agreed to identify all of the companies in which it has an interest of 50 per cent or more, but less than 100 per cent, by using the words "Affiliated with Virginia-Carolina Chemical Co." on their letterheads, contracts, bags, etc. The Macmurphy Co., Charleston, S. C., is the only exception to this identification. There are 18 such affiliated companies, i. e.:

Dothan Guano Co., Dothan, Ala.
Bragaw Fertilizer Co., Washington, N. C.
Blackstone Guano Co., Blackstone, Va.
Rock Hill Fertilizer Co., Rock Hill, S. C.
Independent Guano Co., Greenville, S. C.
Central Georgia Guano Co., Milledgeville, Ga.
Moultrie Fertilizer & Manufacturing Co., Moultrie, Ga.
South Georgia Fertilizer Co., McRae, Ga.
Thomasville Fertilizer Co., Thomasville, Ga.
Commerce Fertilizer Co., Commerce, Ga.
Ocmulgee Guano Co., Hawkinsville, Ga.

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[1] The following changes have been reported by the company since the chart was drawn:

Control of Home Guano Co. and Maysville Guano Co. now 100 per cent instead of 50 per cent.

Control of Rock Hill Fertilizer Co. now 75 per cent instead of 50 per cent.

Interest in Coleman Guano Co., Pamlico Fertilizer Co., and Amalgamated Phosphate Co. disposed of.

Putnam Fertilizer Works, Eatonton, Ga.
Royston Guano & Warehouse Co., Royston, Ga.
Coosa River Fertilizer Co., Wetumpka, Ala.
Fidelity Chemical Corporation, Houston, Tex.
Consumers Chemical Corporation, 24 Broad Street, New York.
Rochelle Guano Works, Rochelle, Ga.
Washington, Alexander & Cooke Co., Charles Town, W. Va.

In the case of The Macmurphy Co., the interest of the Virginia-Carolina Chemical Co. is only 50 per cent, and the management is left entirely to the owners of the remaining 50 per cent, namely, Mr. M. V. Haselden, president, and Mr. W. C. Macmurphy, treasurer and general manager, who have declined to adopt the plan of identification referred to above.

Negotiations have been undertaken by the Virginia-Carolina Chemical Co. to have the companies controlled by the Dothan Guano Co., one of the 50 per cent companies, adopt some identification to disclose that connection. The results of these negotiations were not known at the time of going to press.

The Coleman Guano Co. and the property of the Pamlico Fertilizer Co. have been disposed of, so that they are not included in the above list of companies to be identified.

Plants operated.—The number and character of fertilizer plants operated in 1914 by the Virginia-Carolina Chemical Co. proper and by subsidiary and affiliated companies, by States, is shown in Table 61, below:

TABLE 61.—NUMBER AND CHARACTER OF FERTILIZER PLANTS OPERATED BY VIRGINIA-CAROLINA CHEMICAL CO. PROPER AND BY SUBSIDIARY AND AFFILIATED COMPANIES, AND TOTALS, BY STATES, 1914.

State.	Virginia-Carolina Chemical Co. proper.			Subsidiary companies.			Affiliated companies.		Total.		
	Completo.	Complete except acid chambers.	Dry mixers.	Complete.	Complete except acid chambers.	Dry mixers.	Complete except acid chambers.	Dry mixers.	Complete.	Complete except acid chambers.	Dry mixers.
Virginia	4	......	2	......	......	1	......	1	4	......	4
North Carolina	5	......	2	2	......	10	......	3	7	......	15
South Carolina	7	1	......	1	......	16	1	2	8	2	18
Georgia	8	......	1	1	......	21	......	13	9	......	35
Florida	......	......	2	......	......	1	......	1	......	......	4
Alabama	4	......	......	1	......	5	......	9	5	......	14
Mississippi	......	......	......	......	1	1	......	......	......	1	1
Louisiana	1	......	......	......	......	......	......	......	1	......	......
Texas	......	......	......	......	......	......	......	1	......	......	1
Arkansas	......	......	......	......	......	1	......	......	......	......	1
Tennessee	1	......	......	......	......	......	......	......	1	......	......
West Virginia	......	......	......	......	......	1	......	......	......	......	1
Ohio	1	......	......	......	......	......	......	......	1	......	......
Maryland	......	......	......	1	......	......	......	......	1	......	......
New Jersey	......	......	......	......	......	......	1	......	......	1	......
Total	31	1	7	6	1	57	2	30	37	4	94

The total number of active plants owned and controlled by the Virginia-Carolina Chemical Co. directly and through subsidiaries and affiliated companies is 135, of which 37 are equipped with acid chambers, 4 complete except acid chambers, and 94 are dry mixers. Georgia has 44 plants, of which 9 are complete. South Carolina has 28, of which 8 are complete and 2 complete except acid chambers, and 18 are dry mixers. North Carolina has 22, of which 7 are complete and 15 are dry mixers. Alabama ranks next in order of importance with 19, of which 5 are complete plants and 14 are dry mixers. Virginia has 8 plants—4 complete and 4 dry mixers. There are only 3 plants north of the Potomac and Ohio Rivers, 1 each in Maryland (Baltimore), Ohio (Cincinnati), and New Jersey (Carteret). The plant at Carteret, N. J., completed in 1913, is the only one in strictly northern territory.

Southern Cotton Oil Co.—The Southern Cotton Oil Co. was organized in 1887 in New Jersey with a capital stock of $5,000,000, which was reduced in 1895 to $2,000,000, and increased in June, 1901, subsequent to its acquisition, to $11,000,000. Of this amount $10,000,000 is outstanding and owned by the Virginia-Carolina Chemical Co. The Southern Cotton Oil Co. is engaged in the refining and manufacture of cottonseed oil and its by-products, lard compounds, soap, etc. It also mixes and sells fertilizers. In addition to 8 oil refineries, it has 75 active cotton-oil mills located in the States of North Carolina, South Carolina, Georgia, Alabama, Florida, Louisiana, Tennessee, and Arkansas. Fifty-one of these cotton-oil mills have dry-mixing plants connected with them which mix and sell fertilizers. (See p. 60.) The Southern Cotton Oil Co. also controls the Refuge Cotton Oil Co., with 4 oil mills in Mississippi, one of which mixes and sells fertilizers, and in addition has 3 dry-mixing plants independent of cotton-oil mills, making a total of 55 mixing plants. The sales of fertilizers by the Southern Cotton Oil Co. in 1913 amounted to more than 100,000 tons. A list of these oil mills, showing their location, those having dry mixers, and the capacity of such dry mixers, is given in Table 62 following:

TABLE 62.—LIST OF COTTON OIL MILLS BELONGING TO THE SOUTHERN COTTON OIL CO., AND MIXING CAPACITY OF FERTILIZER PLANTS, 1914.

Location.	Mixing capacity of dry mixers.	Remarks.	Location.	Mixing capacity of dry mixers.	Remarks.
GEORGIA (25 PLANTS).	*Tons.*		GEORGIA—continued.	*Tons.*	
Acworth	500		Dawson	1,700	
Athens	1,600		Forsyth	1,500	
Atlanta	2,500		Fort Gaines	700	
Cartersville	800		Gate City	....	Does not mix fertilizers.
Cedartown	1,600				
Columbus	900		Jackson	900	
Commerce	400		Jefferson	600	
Cordele	1,700		Newnan	....	Do.

TABLE 62.—LIST OF COTTON OIL MILLS BELONGING TO THE SOUTHERN COTTON OIL CO., AND MIXING CAPACITY OF FERTILIZER PLANTS, 1914—Contd.

Location.	Mixing capacity of dry mixers.	Remarks.
GEORGIA—continued.	*Tons.*	
Lavonia	400	
Talbotton	1,200	
Augusta	2,000	
Dublin	900	
Greensboro		Does not mix fertilizers.
Macon	1,200	
Warrenton		Do.
Washington	700	
Waynesboro	3,000	
Savannah	4,000	
SOUTH CAROLINA (22 PLANTS).		
Abbeville		Do.
Barnwell	500	
Greenwood	2,000	
Laurens	500	
Spartanburg	2,500	
Bennettsville		Do.
Camden		Do.
Charleston	10,000	
Chester	2,000	
Columbia		Do.
Darlington	500	
Dillon	1,200	
Florence	600	
Newberry	1,000	
Orangeburg		Do.
St. Matthews	300	
Sumter		Do.
Union	700	
Winnsboro	300	
Allendale	2,700	Fertilizer plant operated separately.
Greenville	1,200	Do.
Kingstree	600	Do.
NORTH CAROLINA (15 PLANTS).		
Conetoe		Does not mix fertilizers.
Charlotte		Do.
Concord	300	
Davidson	300	
Gastonia		Does not mix fertilizers.
Gibson	2,500	
Monroe	1,500	
NORTH CAROLINA—con.	*Tons.*	
Shelby	2,500	
Wadesboro	2,000	
Fayetteville	3,000	
Goldsboro	4,500	
Rocky Mount	5,000	
Selma		Does not mix fertilizers.
Tarboro		Do.
Wilson	3,000	
ARKANSAS (2 PLANTS).		
Little Rock	7,000	
Newport		Do.
TENNESSEE (1 PLANT).		
Memphis		Do.
ALABAMA (11 PLANTS).		
Andalusia	1,000	
Alexander City		Do.
Cullman		Do.
Decatur	3,500	
Dothan		Do.
Greenville		Do.
Linden		Do.
Montgomery	4,000	
Sheffield	600	
Sylacauga		Do.
Union Springs	300	
FLORIDA (1 PLANT).		
Pensacola	1,200	
LOUISIANA (1 PLANT).		
New Orleans		Do.
MISSISSIPPI (4 PLANTS).		
Refuge Cotton Oil Co.		
Columbus	3,500	
Greenville		Do.
Rosedale		Do.
Vicksburg		Do.
Total	101,100	

In acquiring the Southern Cotton Oil Co. the Virginia-Carolina Chemical Co., in a circular to its stockholders, made the following statement concerning the cottonseed-oil business:

> Your board then took up the question of ammoniate supply, as your company consumes about $2,000,000 worth of ammoniates per annum. Investigation demonstrated that the best means to supply ammoniates of its own manufacturing was through the medium of cottonseed meal. Further investigation of the cottonseed-oil business demonstrated very great possibilities and profits from it as a business of itself. But great as the possibilities of the cottonseed-oil business are in itself, far greater are its possibilities worked in connection with such a fertilizer business as we do, where they go hand and glove together, bringing us into closer touch with our fertilizer customers, enabling us frequently to advantageously trade manufactured fertilizers for cotton seed, enormously increasing our means of distribution, and still further assisting us to reach the fertilizer consumers and upon the lowest possible freight rates.

Since the Southern Cotton Oil Co. sells in competition with the Virginia-Carolina Chemical Co., by which it is controlled, the bags of the former will be marked with the words "Subsidiary of Virginia-Carolina Chemical Co.," so that this relationship may be known to the purchasers of its fertilizers. (See p. 184.)

Affiliated companies.—As is shown by the chart facing page 184, the Virginia-Carolina Chemical Co. in 1914 held an interest in 21 affiliated companies having 22 active plants. Two of these were acidulating or wet-mixing plants, the rest were dry mixers. One affiliated holding company, the Dothan Guano Co., Dothan, Ala., held a stock interest ranging from 100 per cent to 50 per cent in eight dry mixers located in Alabama and Florida. The Bragaw Fertilizer Co., Washington, N. C., held a stock interest in the Pamlico Chemical Co. with two dry mixers at Washington and Bayboro, N. C. Including the plants in which the Dothan Guano Co. and the Bragaw Fertilizer Co. had an interest, the total number of affiliated fertilizer plants was 32, of which 2 were wet mixers and 30 dry mixers.

The interest acquired by the Virginia-Carolina Chemical Co. in the affiliated companies directly controlled is usually 50 per cent, local subscribers taking the other 50 per cent. The local subscribers have the right to select the president and manager subject to the supervision of the Virginia-Carolina Chemical Co. and to name one-half of the board of directors. The acid phosphate and potash salts required by the affiliated company are to be purchased from the Virginia-Carolina Chemical Co., provided the prices are not in excess of the general market prices. Other materials may be purchased elsewhere, provided they can be secured at a lower price than from the Virginia-Carolina Chemical Co. The acid phosphate and potash salts furnished by the Virginia-Carolina Chemical Co. may be purchased on credit subject to certain conditions. If at the end of any fiscal year the capital stock has become impaired or the earnings are unsatisfactory, the Virginia-Carolina Chemical Co. has the right to name a price at which it will sell its stock or buy the stock of the other stockholders, which price shall be the same, and both parties are bound to either buy or sell. The Virginia-Carolina audits the books of these affiliated dry mixers and controls their purchases. The company reports that in some cases this plan has not proven a success.

As indicated above (see p. 184), all of the companies in which the Virginia-Carolina Chemical Co. holds as much as a 50 per cent interest, with the exception of The Macmurphy Co., will use the words "Affiliated with the Virginia-Carolina Chemical Co." on their letterheads, advertising matter, contracts, bags, etc.

Extent of fertilizer control.—Prior to 1903 the Virginia-Carolina Chemical Co. appears to have secured control of nearly all of the independent fertilizer concerns in the States of Georgia, South Carolina, and Alabama. The Commercial and Financial Chronicle of May 24, 1902, contained the following statement regarding the situation in Alabama:

> The company (Virginia-Carolina Chemical Co.) confirms the report that it has arranged to purchase: Montgomery Fertilizer Co., and Alabama Fertilizer Co., both of Montgomery; Opelika Chemical Co., of Opelika; Mobile Phosphate Co., of Mobile; and Pacific Chemical Co., of Dothan, leaving only one independent fertilizing manufacturing plant in Alabama, viz, at Troy.

In regard to the control of the fertilizer business in Georgia and South Carolina the Commercial and Financial Chronicle of November 4, 1899, stated:

> The company (Virginia-Carolina Chemical Co.) has purchased the plants of the Commercial Guano Co., at Savannah and Columbus * * *. The Macon (Ga.) Telegraph says:
>
> "This practically gives the company control of the fertilizer business. * * * The recent purchase gives the Richmond corporation every fertilizer factory at Savannah with the exception of the Savannah Guano Co. It is said that there is only one other fertilizer factory in the State which is not controlled by this corporation—a small plant at Valdosta. Much the same condition exists in South Carolina."

In recent years competition has sprung up rapidly in the fertilizer business in these southern States. This has been particularly true since the banner year of 1910. As a result the percentage of the total number of plants operated by the Virginia-Carolina Chemical Co. has declined. Table 63 shows the situation in Georgia, South Carolina, and Alabama in 1914.

TABLE 63.—PLANTS OPERATED BY THE VIRGINIA-CAROLINA CHEMICAL CO. AND OTHER COMPANIES IN THE STATES OF ALABAMA, GEORGIA, AND SOUTH CAROLINA, BY CLASSES, 1914.

Company.[1]	Alabama.				Georgia.				South Carolina.			
	Complete.	Complete except acid chambers.	Dry mixers.		Complete.	Complete except acid chambers.	Dry mixers.		Complete.	Complete except acid chambers.	Dry mixers.	
			Connected with cotton oil mills.	Other.			Connected with cotton oil mills.	Other.			Connected with cotton oil mills.	Other.
Virginia-Carolina Chemical Co.	5		5	9	9		21	14	8	2	13	5
The American Agricultural Chemical Co.	1				1				2	1		1
International Agricultural Corporation		2		6		[2] 10		31		4		3
Armour Fertilizer Works				2	2	1	1	12				
Swift & Co.					1	1		2				2
F. S. Royster Guano Co.				1	1			1	1			1
Other companies	7	5	35	57	17	11	63	173	5	2	29	30
Total	13	7	40	75	31	23	85	233	16	9	42	42

[1] Including subsidiaries and affiliated companies.

[2] Includes 3 plants equipped with acid chambers, which were acquired by lease the latter part of 1914.

In Alabama the Virginia-Carolina Chemical Co. in 1914 operated only 19 out of a total of 135 plants. The other large companies together operated 12 plants. Seven of the 13 complete plants, 5 of the 7 wet mixers, and 92 of the 115 dry mixers were operated by companies independent of the six large concerns. Likewise, in Georgia the Virginia-Carolina Chemical Co. operated only 44 out of a total of 372 plants. The other large companies together operated 64 plants. Seventeen of the 31 complete plants, 11 of the 23 wet mixers, and 236 of the 318 dry-mixing plants were operated by companies other than the 6 large concerns. In South Carolina the Virginia-Carolina Chemical Co. operated 28 out of a total of 109 plants. The other large companies operated 15 plants. Companies other than the 6 largest operated 5 out of a total of 16 complete plants, 2 out of a total of 9 complete plants, except acid chambers, and 59 out of a total of 84 dry-mixing plants.

In this connection it should be noted that the average production of the Virginia-Carolina Chemical Co.'s plants is somewhat greater than that of the plants included under the head of "other plants," many of which are comparatively small dry mixers. For instance, in 1914 the Virginia-Carolina Chemical Co. operated 14 per cent of the plants in Alabama and 12 per cent in Georgia but did 18.5 per cent of the business in the former State and 16.8 per cent of the business in the latter. (See p. 176.)

Mining and other companies.—The Virginia-Carolina Chemical Co. has three subsidiary mining companies—Charleston (S. C.) Mining & Manufacturing Co., United Phosphate & Chemical Co., and Sulphur Mining & Railroad Co. The Charleston (S. C.) Mining & Manufacturing Co., incorporated in South Carolina, is controlled by the Virginia-Carolina Chemical Co., through ownership of the entire $2,219,200 outstanding capital stock. This company is engaged in the mining and sale of phosphate rock. Its phosphate properties are located in South Carolina, Tennessee, and Florida. The company owns in fee or has the mineral rights to 75,800 acres of phosphate-rock properties, together with seven plants for mining, preparing, and shipping phosphate rock. It also owns about 64 miles of railroad. The area of Florida land pebble rock is 9,620 acres; of Tennessee brown and blue rock, 12,811 acres; and of South Carolina land rock, 53,370 acres. The total quantity of rock owned is estimated by the company at about 47,000,000 tons.

The United Phosphate & Chemical Co., Richmond, Va., owns phosphate lands in Arkansas, which at the present time are not being operated, and the Sulphur Mining & Railroad Co., Richmond, Va., owns extensive sulphur or brimstone deposits in Mexico and pyrites mines in Virginia and Georgia. The Virginia-Carolina Chemical Co. controls these two companies through ownership of the capital stock.

The Virginia-Carolina Chemical Co. also has several affiliated companies not engaged in the manufacture and sale of fertilizers. In 1914 it owned a 50 per cent interest in the Amalgamated Phosphate Co., Baltimore, Md. ($2,850,000 outstanding), which is engaged in mining phosphate rock in Polk County, Fla. The balance of the outstanding stock was owned by Baugh & Sons Co., Philadelphia, Pa.; H. J. Baker & Bro. (brokers), New York, N. Y.; and Wilson & Toomer Fertilizer Co., Jacksonville, Fla. In 1915 the Amalgamated Phosphate Co. was acquired by the Ammo-Phos Corporation, which is owned by the Virginia-Carolina Chemical Co. and James B. Duke. The Virginia-Carolina Chemical Co. also has a 65 per cent interest in the Steel Cities Chemical Co., Birmingham, Ala., and a 36 per cent interest in the Ammoniated Humus Co., Dothan, Ala. Two other important affiliated companies are the Gewerkschaft-Einigkeit, Fallersleben, Germany, and Chemical Works, Schönebeck (Ltd.) Germany. Neither of these two concerns does business in the United States.

Section 6. The American Agricultural Chemical Co.

Organization and capitalization.—The American Agricultural Chemical Co. was organized in May, 1899, as successor to the Agawa Co., which was incorporated under the laws of Connecticut by special charter in 1893. It is the second largest fertilizer manufacturing company in point of total output and the largest manufacturer of mixed goods.

The capital stock authorized at the date of consolidation (May, 1899) was $40,000,000, divided into $20,000,000 common and $20,000,000 6 per cent cumulative preferred. This was increased in 1912 to $50,000,000 of each class. The amount of stock outstanding April 15, 1915, was $18,430,900 common and $27,558,200 preferred, and the total amount of bonds $16,453,000—$9,453,000 first mortgage and $7,000,000 debenture bonds.

Good-will account.—The balance sheet of The American Agricultural Chemical Co., including subsidiaries, for the fiscal year 1910, showed an item of $15,984,869.17 for brands, trade-marks, patents, and good will, which was approximately 44 per cent of the total capital stock outstanding of $36,004,700. Since 1910 this good-will account on the books of the company has been considerably reduced by deducting therefrom increases in value of plants and equipment and phosphate holdings. In 1912, for instance, a reduction of over $11,600,000 was made by this means, about $333,000 having been likewise deducted in 1911.

The phosphate properties of the company in 1911 were valued at $3,885,912.37 and in 1912 at $16,803,942.94, an increase of $12,918,030.57, or about 332 per cent. This item has since been increased to $16,975,471.38 in 1914. The item of lands, buildings, and machinery in 1910 was $8,175,769.33 and in 1914, $14,319,789.78, an increase of more than 75 per cent in the five-year period. The great increase here again occurred in 1912, when $2,908,321.74 was added to the $9,586,174.01 value given in 1911.[1]

At the close of the fiscal year 1914 the company reported a brands, trade-marks, patents, and good-will item of $4,141,899.92 as compared with a total capital stock outstanding of $45,443,600, or only about 9 per cent.

Companies acquired.—The prospectus of the company (May, 1899), in referring to the numerous corporations and firms taken over, contains the following statement:

> These companies are recognized as the strongest concerns, with the best-equipped plants, engaged in the manufacture of fertilizers in the Northern and

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[1] In explanation of these changes, Thomas A. Doe, treasurer, in a statement to stockholders Aug. 23, 1912, says as follows:

"The appraisal of the company's plants, in which work Messrs. Westinghouse, Church, Kerr & Co. have been engaged for more than a year past, has been completed. They have made a thorough examination of all the manufacturing plants and warehouses of the company and have rendered detailed appraisals on same, aggregating $13,342,755.14, against the book values of these properties of $10,917,028.36. * * *

"Inasmuch as this independent appraisal represents the present sound values of these properties, the directors have decided to place the same upon the books of the company, charging off the increase to brands, trade-marks, and good-will account. * * *

"A conservative estimate (based on recent transactions in such properties) would fix the value of these lands (Florida phosphate lands) at over $15,000,000. While the company has been carrying these properties at actual cost, the directors have decided to place their real value upon the books, making a corresponding decrease in the good-will account."

Eastern States, and are so located at distributing centers as to enable them to market their products at a minimum cost.

The following is a list of the constituent companies of The American Agricultural Chemical Co. acquired prior to 1902, as shown by the prospectus of the company, 1899, New York Stock Exchange listing statement, 1901, and Moody's Manual, 1902. It will be noticed that but one of these companies is located south of Baltimore, Md.:

Acme Fertilizer Co., New York, N. Y.
Alexandria Fertilizer & Chemical Co. ($25,000), Alexandria, Va.
Bradley Fertilizer Co. ($400,000), Boston, Mass., and Los Angeles, Cal.
Chemical Co. of Canton, The ($100,000), Baltimore, Md.
Chicopee Guano Co., The, New York, N. Y.
Clarks Cove Fertilizer Co., Maine.
Cleveland Dryer Co., The ($100,000), Cleveland, Ohio.
Crocker Fertilizer & Chemical Co. ($400,000), Buffalo, N. Y.
Cumberland Bone Phosphate Co. ($50,000), Boothbay Harbor, Me.
Darling Fertilizer Co., L. B. ($200,000), Pawtucket, R. I.
Detrick Fertilizer & Chemical Co., The ($100,000), Baltimore, Md.
East India Chemical Works (H. J. Baker & Bro.), Brooklyn, N. Y.
Empire Carbon Works ($40,000), East St. Louis, Ill.
Great Eastern Fertilizer Co., New York, N. Y.
Lazaretto Guano Co., The ($300,000), Baltimore, Md.
Liebig Manufacturing Co. ($1,500,000), Wilmington, Del., and Carteret, N. J.
Listers' Agricultural Chemical Works ($600,000), Newark, N. J.
Long Island Agricultural Chemical Co., The, New York, N. Y.
Maryland Fertilizer & Manufacturing Co. ($105,000), Baltimore, Md.
Michigan Carbon Works ($600,000), Detroit, Mich.
Milsom Rendering & Fertilizer Co. ($400,000), Buffalo, N. Y.
Moro-Phillips Fertilizer Co. ($50,000), Philadelphia, Pa.
Nickerson Fertilizer Co. ($40,000), Easton, Md.
Northwestern Fertilizing Co. ($250,000), Chicago, Ill.
Pacific Guano Co. (Maine corporation), Maine.
Packers' Fertilizer Association, The, Illinois.
Packers' Union Fertilizer Co., New York, N. Y.
Poultry & Farm Supply Co., The, Maine.
Preston Fertilizer Co. ($100,000), Brooklyn, N. Y.
Quinnipiac Co., The ($50,000), Boston, Mass.
Read Fertilizer Co. ($100,000), Brooklyn, N. Y.
Sharpless & Carpenter ($50,000), Philadelphia, Pa.
Slingluff & Co., Baltimore, Md.
Standard Fertilizer Co. ($50,000). (Name changed to The American Agricultural Chemical Co. of Massachusetts.)
Suffolk Fertilizer Co., The ($50,000), New York, N. Y.
Susquehanna Fertilizer Co. ($100,000), Baltimore, Md.
Tygert-Allen Fertilizer Co., The ($150,000), Carteret, N. J.
Wheeler & Co., M. E., Rutland, Vt.
Williams & Clark Fertilizer Co. ($300,000), Carteret, N. J.
Zell Guano Co., The ($250,000), Baltimore, Md.

All the above companies are reported as inactive, not owing or owning anything.

Important fertilizer companies acquired since 1902 are enumerated in the list which follows:

Brooklyn Fertilizer Co.
[1] Bowker Fertilizer Co.,[2] Elizabeth, N. J.; Brighton, Mass.; St. Bernard, Ohio.
Hamberton & Hance, Freehold, N. J.
Demise & Demise, Freehold, N. J.
[1] Ashepoo Fertilizer Co. ($100,000), Charleston, S. C.
Bigbee Fertilizer Co., Montgomery, Ala.
Buffalo Rendering Co., Buffalo, N. Y.
Dixie Guano Co., Spartanburg, S. C.
Farmers' Fertilizer Co., Spartanburg, S. C.
[1] Farmer Co., W. S., Baltimore, Md.
Goulding Fertilizer Co., The, Pensacola, Fla.
Pensacola Fertilizer Co., Pensacola, Fla.
[1] Southern Fertilizing Co., Baltimore, Md.
[1] The Coe-Mortimer Co. ($700,000), Belfast, Me., and Charleston, S. C.
[1] Palmetto Guano Corporation, Columbia, S. C.
[1] Pocomoke Guano Co., The, Norfolk, Va.
[1] Sanderson Fertilizer & Chemical Co., West Haven, Conn.

Most of the southern companies in the above list have been taken over since 1910. Beginning with that year the company became more aggressive in the southern field. In addition to the acquisition of some nine concerns, it has built three new plants—one at Savannah, Ga., where 70 acres of land had been purchased; another at Wilmington, N. C.; and a third at Columbia, S. C., and has also established a plant at Jacksonville, Fla., which is operated under lease by its subsidiary, The American Agricultural Chemical Co. of Florida.

The American Agricultural Chemical Co., in 1914, owned the stock of 10 active companies engaged in the manufacture and sale of fertilizer, and of 17 companies engaged in selling fertilizers only. It also has various other subsidiaries engaged in other lines of business. It has no affiliated fertilizer companies. The active subsidiary companies of The American Agricultural Chemical Co., together with the location and character of the plants operated by them and by the parent company, are shown by the chart of corporate organization facing this page.[3]

Identification of companies.—The American Agricultural Chemical Co. has voluntarily agreed to identify all its subsidiary fertilizer manufacturing and selling companies by placing on their letterheads, contracts, advertising matter, and bags the words "Subsidiary of The American Agricultural Chemical Co." The following companies will be thus identified:

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[1] Active in 1914.

[2] Business and property acquired but not the capital stock.

[3] The following changes have been reported since the chart was drawn: The plant at Savannah, Ga., is now operated by The American Agricultural Chemical Co. of Delaware. The Florida phosphate rock lands, with the exception of those owned by the Palmetto Phosphate Co., have been taken over by The American Phosphate Mining Co., a Delaware corporation.

Manufacturing and selling fertilizers:

Alexandria Fertilizer & Chemical Co., Alexandria, Va.
Bowker Fertilizer Co., Elizabeth, N. J.
The Coe-Mortimer Co., New York, N. Y.
Empire Carbon Works, East St. Louis, Ill.
Palmetto Guano Corporation, Columbia, S. C.
The Pocomoke Guano Co., Norfolk, Va.
Sanderson Fertilizer & Chemical Co., West Haven, Conn.

Selling fertilizers only:

Josiah Cope & Co., Baltimore, Md.
The Berkeley Chemical Co., Norfolk, Va.
The Hampton Guano Co., Norfolk, Va.
S. M. Hess & Bro. (Inc.), Philadelphia, Pa.
The Imperial Co., Norfolk, Va.
Frederick Ludlum Co., Baltimore, Md.
Nassau Fertilizer Co., New York, N. Y.
The National Fertilizer Co., Boston, Mass.
The Norfolk Fertilizing Co. (Inc.), Norfolk, Va.
Patapsco Guano Co., Baltimore, Md.
The Pollock Fertilizer Co., Baltimore, Md.
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.
The J. E. Tygert Co., Philadelphia, Pa.
W. E. Whann Co., Philadelphia, Pa.
The Robert A. Wooldridge Co., Baltimore, Md.
W. S. Farmer & Co., Baltimore, Md.
Southern Fertilizing Co., Baltimore, Md.

In the case of Lister's Agricultural Chemical Works, Newark, N. J., 124 shares of whose stock is not owned by The American Agricultural Chemical Co., the words "Affiliated with The American Agricultural Chemical Co." will be used. On the chart, however, this company has been classed as a subsidiary, since the stock not owned constitutes only about 2 per cent of the total.

Number of fertilizer plants operated.—As the chart shows, The American Agricultural Chemical Co. proper in 1914 operated 10 complete plants equipped with acid chambers; 2 complete plants, except acid chambers; and 4 dry-mixing plants, 1 of which is located at Habana, Cuba. Its various subsidiaries together operated 8 complete plants equipped with acid chambers; 4 complete plants, except acid chambers; and 2 dry mixers. The distribution of the fertilizer plants of The American Agricultural Chemical Co. and its subsidiaries by States is shown by Table 64.

TABLE 64.—NUMBER AND CHARACTER OF FERTILIZER PLANTS OPERATED BY THE AMERICAN AGRICULTURAL CHEMICAL CO. PROPER AND BY SUBSIDIARY COMPANIES, AND TOTALS, BY STATES, 1914.

State.	The American Agricultural Chemical Co. proper.			Subsidiary companies.			Total.		
	Complete.	Complete except acid chambers.	Dry mixers.	Complete.	Complete except acid chambers.	Dry mixers.	Complete.	Complete except acid chambers.	Dry mixers.
Maine			1			1			2
Massachusetts	1						1		
Connecticut					1			1	
New York	1		1				1		1
New Jersey	2			2			4		
Pennsylvania		1						1	
Maryland	1		1				1		1
Ohio				2			2		
Michigan	1						1		
Illinois					1			1	
Virginia				1	1		1	1	
North Carolina				1			1		
South Carolina	2	1				1	2	1	1
Georgia	1						1		
Florida				1	1		1	1	
Alabama	1						1		
California				1			1		
Total, United States	10	2	3	8	4	2	18	6	5
Cuba			1						1

The 30 plants of the company, including subsidiaries, are distributed over 17 States, extending from Maine to Florida and California. There are four each in New Jersey and South Carolina, two each in Maine, New York, Maryland, Ohio, Virginia, and Florida, one each in nine other States, and one in Cuba.

The fertilizer plants operated by the subsidiaries of the American Agricultural Chemical Co., as shown by the chart facing page 194, are as follows:

[1] The American Agricultural Chemical Co. of Delaware, four complete fertilizer plants located at Los Angeles, Cal.; Wilmington, N. C.; Rockport (near Cleveland) and St. Bernard (near Cincinnati), Ohio.

[1] The American Agricultural Chemical Co. of Florida, one complete plant at Pensacola, and the complete plant, except acid chambers, at Jacksonville, Fla.

[1] Alexandria Fertilizer & Chemical Co., one complete plant at Alexandria, Va.

[1] Bowker Fertilizer Co., one complete plant at Elizabeth, N. J.

The Coe-Mortimer Co., one complete plant, except acid chambers, at Belfast, Me.

[1] Empire Carbon Works, one complete plant, except acid chambers, at East St. Louis, Ill.

Listers' Agricultural Chemical Works of New Jersey, one complete plant at Newark, N. J.

Palmetto Guano Corporation, one dry-mixing plant at Columbia, S. C.

[1] The Pocomoke Guano Co., one complete plant, except acid chambers, at Norfolk, Va.

Sanderson Fertilizer & Chemical Co., one complete plant, except acid chambers, at West Haven, Conn.

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[1] Operates under lease.

Selling companies.—As shown by the chart facing page 194, The American Agricultural Chemical Co. has 17 active subsidiary companies engaged exclusively in selling under their own name various brands of fertilizers which it puts up for them. Eight of these 17 selling companies operate from Baltimore where The American Agricultural Chemical Co. proper has but one complete plant and one dry mixer. Four operate from Norfolk, where there is only one plant owned by The American Agricultural Chemical Co. proper, which is operated by The Pocomoke Guano Co. under lease. Three operate from the Philadelphia office. In addition to the above selling companies several of the subsidiary companies manufacturing fertilizers are used as selling companies. Thus, The Coe-Mortimer Co. operates only one plant, that at Belfast, Me., yet it sells fertilizers, manufactured at other plants of The American Agricultural Chemical Co., in New York, Pennsylvania, Ohio, North Carolina, South Carolina, and Georgia. The Bowker Fertilizer Co. operates only one fertilizer-manufacturing plant, that at Elizabeth, N. J., yet it sells fertilizers, manufactured at other plants, in Ohio, North Carolina, and other distant States.

The company reports that all of these selling companies were formerly independent concerns. Several of them before being acquired were jobbers who sold under their own brand names fertilizers manufactured for them by The American Agricultural Chemical Co. They have continued to operate in the same manner since their acquisition. Several other selling companies were formerly subsidiaries of The Pocomoke Guano Co., of Norfolk. Their operation has been continued along with that of the manufacturing company since their acquisition. One company lost its plant by fire and sold its brands and good will to The American Agricultural Chemical Co., which has continued to supply its trade.

There are several other companies taken over by The American Agricultural Chemical Co. which apparently have been operated as active selling companies although reported as inactive. Thus, in South Carolina, the Bradley, Ashepoo, Dixie, Homestead, and Farmers' fertilizer companies, supposedly inactive American Agricultural Chemical Co. companies, registered brands under their own names as manufacturers in the 1912–13 and 1913–14 seasons. The total number of active and so-called inactive companies of The American Agricultural Chemical Co. thus registering brands in South Carolina in these years was 11, as follows:

The Coe-Mortimer Co., Charleston, S. C.
The Pocomoke Guano Co., Norfolk, Va.
The Hampton Guano Co., Norfolk, Va.
The Berkeley Chemical Co., Norfolk, Va.
The Norfolk Fertilizing Co. (Inc.), Norfolk, Va.
Bradley Fertilizer Co., Boston, Mass.

Ashepoo Fertilizer Co., Charleston, S. C.
The Imperial Co., Norfolk, Va.
Dixie Guano Branch, Spartanburg, S. C., 1913–14 season.
Homestead Fertilizer Branch, Spartanburg, S. C., 1913–14 season.
Farmers' Fertilizer Works, Spartanburg, S. C., 1913–14 season.

In New York State, which ranks fifth in order of importance as a consumer of fertilizers and first among the Northern States, with an estimated consumption of 460,000 tons in 1913, The American Agricultural Chemical Co. has only two fertilizer plants, a complete plant at Buffalo and a dry-mixing plant at Brooklyn. None of the subsidiary fertilizer manufacturing companies operates a plant within the State. Notwithstanding this fact the parent company and 12 subsidiary companies registered brands in 1913 with the New York Department of Agriculture, as follows:

Name.	Address.	Number of brands
The American Agricultural Chemical Co	New York	259
Bowker Fertilizer Co	do	37
The Coe-Mortimer Co	do	34
Listers' Agricultural Chemical Co	Newark, N. J	36
Sanderson Fertilizer & Chemical Co	New Haven, Conn	8
S. M. Hess & Bro	Philadelphia, Pa	20
Frederick Ludlam Co	New York, N. Y	10
Nassau Fertilizer Co	do	11
National Fertilizer Co	do	3
Patapsco Guano Co	Baltimore, Md	16
Schaal-Sheldon Fertilizer Co	Buffalo, N. Y	16
The J. E. Tygert Co	Philadelphia, Pa	5
W. E. Whann Co	do	4
Total		459

The first four of the subsidiary companies are reported to the Commission as manufacturers and the other eight as selling companies. The plant of The Coe-Mortimer Co., however, is located at Belfast, Me., and that of the Sanderson Fertilizer & Chemical Co., at West Haven, Conn. Two hundred and thirty of the 259 brands of The American Agricultural Chemical Co., shown above, were registered under the names of 19 of its acquired and constituent companies, which are reported as inactive, the remaining 29 brands being registered under its own name.[1]

The registration of the brands of these inactive companies was made in the name of The American Agricultural Chemical Co., as

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[1] The following list shows the names and number of brands registered in New York in 1913 by The American Agricultural Chemical Co.:

The American Agricultural Chemical Co	29
Acme brands	6
Bradley brands	26
Clark's Cove brands	2
Crocker brands	20
Darling's brands	2
East India brands	26
Great Eastern brands	11
Lazaretto brands	9
Michigan Carbon works brands	6
Milsom brands	16
Northwestern brands	21
Pacific brands	2
Packers' Union brands	7
Quinnipiac brands	8
Read brands	19
Reese brands	6
Wheeler brands	10
Williams & Clark brands	24
Zell brands	9
Total	259

the annual reports of the Commissioner of Agriculture for New York State showed, and the bills of lading and contracts made with dealers also bore the same name, but on the advertising matter of some of these brands which was distributed to the farmers there was nothing to indicate that there was any connection between the companies and The American Agricultural Chemical Co. except the street number of the office. For instance, the address of the L. B. Darling Fertilizer Works was given as 92 State Street, Boston, Mass., and 2 Rector Street, New York, and that of the Williams & Clark Fertilizer Works as 2 Rector Street, New York; 92 State Street, Boston; 1015 Fidelity Building, Baltimore; Lewis and Lyman Streets, Buffalo; 897 Drexel Building, Philadelphia, Pa., which are also the addresses of the offices of The American Agricultural Chemical Co. The address of several of these companies was given as 60 Trinity Place, which is another entrance to the United States Express Co. Building at 2 Rector Street, New York, N. Y.

Hereafter these more or less inactive subsidiary companies will be identified in the same manner as the active subsidiaries (see p. 194) so that in every instance the name of The American Agricultural Chemical Co. will appear on the letterheads, advertising matter, contracts, bags, etc.

Phosphate properties and mining companies.—The American Agricultural Chemical Co. through subsidiaries owns real estate in Florida comprising over 108,000 acres, estimated to contain more than 75,000,000 tons of phosphate rock. Part of the above acreage does not contain any phosphate rock, and another part has not been prospected. The company also owns about 2,000 acres of unprospected lands in Tennessee.

The American Phosphate Mining Co., a Delaware corporation, has recently taken over all of the Florida rock properties formerly held by the Pebbledale Phosphate Co., Pierce Phosphate Co., and Peace River Phosphate Co.

The Palmetto Phosphate Co., another subsidiary corporation, owns upward of 23,000 acres (included in the 108,000 acres mentioned above) of phosphate-rock lands in Florida located along the lines of the Charlotte Harbor & Northern Railway Co., Atlantic Coast Line, and the Seaboard Air Line Railway Co., which land The American Agricultural Chemical Co. states contains approximately 24,000,000 tons of high-grade merchantable and minable phosphate rock. It also owns mining stations, washing and drying plants, and a steam railroad several miles in length. The capital stock of this company is $500,000 and bonded indebtedness $130,327. According to the listing statement of The American Agricultural Chemical Co., filed with the Stock Exchange December 19, 1911, $770,200 of its preferred stock and $1,115,300 of its common stock were issued for the purpose of paying for 3,081 shares of the Palmetto Phosphate Co. The American Agricultural Chemical Co. now owns all but 20 shares.

Miscellaneous activities.—As shown by the chart facing page 194, The American Agricultural Chemical Co. operates directly two rendering establishments—one at Buffalo and the other at Brooklyn, N. Y. One of the subsidiaries manufacturing fertilizers, the Lister's Agricultural Chemical Works at Newark, N. J., is also engaged in rendering and manufacturing glue, grease, bone black, etc.

The company also has four subsidiaries engaged exclusively in rendering, etc., and four other subsidiaries engaged in collecting and dealing in bones, fat, abattoir refuse, etc. Other subsidiaries engaged in miscellaneous business are the G. C. Buquo Lime Co. and the Pownal Lime Co., which operate lime quarries at Hot Springs, N. C., and North Pownal, Vt., respectively; the Bowker Chemical Co., Elizabeth, N. J., which manufactures and sells phosphoric-acid products; Bowker Insecticide Co., Baltimore, Md., and Everett, Mass., which manufactures and sells insecticides, fungicides, and kindred products; and Aroostook Warehouse Co. and Knyvetta Dock & Warehouse Co., which conduct warehouses for potatoes, fertilizers, etc., in Maine.

The American By-Products Co. (Illinois) and The Coe-Mortimer Chemical Co., Newark, N. J., hold real estate in Illinois and New Jersey, respectively, but are not engaged in active business.

The American Agricultural Chemical Co. also owns the entire capital stock of the Charlotte Harbor & Northern Railway Co., incorporated March 26, 1906, in Florida, which extends from deep water at Charlotte Harbor, Fla., to the principal pebble phosphate-mining properties of the company. The length of the road is about 120 miles, the construction of which has been paid for by The American Agricultural Chemical Co. The road is capitalized at $2,000,000, consisting of $500,000 5 per cent preferred and $1,500,000 common.

Section 7. Armour Fertilizer Works.

Organization and capitalization.—The Armour Fertilizer Works was incorporated August 14, 1909, under the laws of New Jersey with a capital stock of $1,000,000, all owned by stockholders of Armour & Co., an Illinois corporation. There is no funded indebtedness. The Armour Fertilizer Works now ranks third in point of output of bagged goods. Its stockholders own all of the stock of 6 subsidiary fertilizer manufacturing companies and of 6 subsidiary selling companies and also $\frac{17}{25}$ of the stock of one affiliated fertilizer concern—the Boaz Fertilizer Co. In 1914 they also controlled through intermediaries 12 additional companies, 10 of which were located in Georgia. The subsidiaries of the Armour Fertilizer

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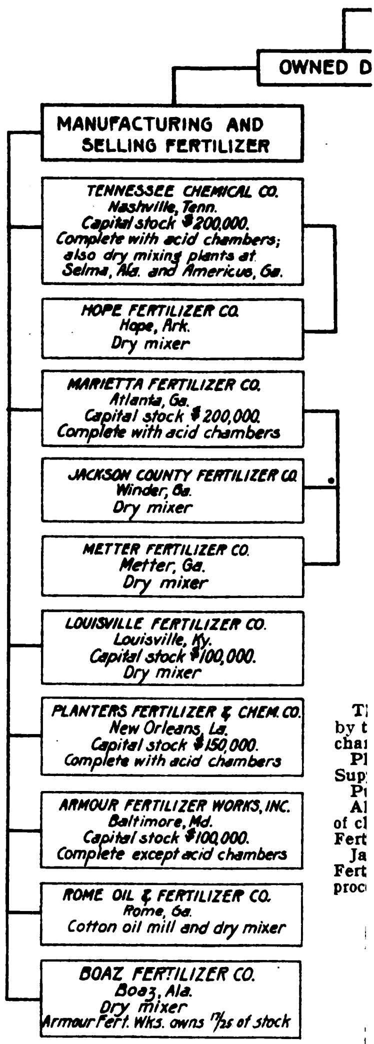
CHROME, N.J. Co
ATLANTA, GA.
JACKSONVILLE, FLA.
HOUSTON, TEX.
BUENA VISTA, VA.
GREENSBORO, N.C.
CHICAGO, ILL.
E. ST. LOUIS, ILL.


OWNED D
MANUFACTURING AND SELLING FERTILIZER
TENNESSEE CHEMICAL CO. Nashville, Tenn. Capital stock $200,000. Complete with acid chambers; also dry mixing plants at Selma, Ala. and Americus, Ga.
HOPE FERTILIZER CO. Hope, Ark. Dry mixer
MARIETTA FERTILIZER CO. Atlanta, Ga. Capital stock $200,000. Complete with acid chambers
JACKSON COUNTY FERTILIZER CO. Winder, Ga. Dry mixer
METTER FERTILIZER CO. Metter, Ga. Dry mixer
LOUISVILLE FERTILIZER CO. Louisville, Ky. Capital stock $100,000. Dry mixer
PLANTERS FERTILIZER & CHEM. CO. New Orleans, La. Capital stock $150,000. Complete with acid chambers
ARMOUR FERTILIZER WORKS, INC. Baltimore, Md. Capital stock $100,000. Complete except acid chambers
ROME OIL & FERTILIZER CO. Rome, Ga. Cotton oil mill and dry mixer
BOAZ FERTILIZER CO. Boaz, Ala. Dry mixer Armour Fert. Wks. owns 17/25 of stock

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Works, together with the location and character of the plants operated by them and by the parent company in 1914, are shown by the chart of corporate organization, facing page 200.

Identification of companies.—The Armour Fertilizer Works has voluntarily agreed to identify its active subsidiary manufacturing and selling companies with the words "Armour owned." This expression has been chosen rather than "subsidiary of," because the stockholders of the Armour Fertilizer Works and not the corporation itself hold the stock of these companies. Seven manufacturing subsidiaries and four selling companies will be identified as stated, viz:

Manufacturing and selling fertilizer:

Tennesse Chemical Co., Nashville, Tenn.
Marietta Fertilizer Co., Atlanta, Ga.
Louisville Fertilizer Co., Louisville, Ky.
Planters' Fertilizer & Chemical Co., New Orleans, La.
Rome Oil & Fertilizer Co., Rome, Ga.
Hope Fertilizer Co., Hope, Ark.
Farmers' Cooperative Fertilizer Co., Blackstone, Va.

Selling fertilizers only:

Macon Fertilizer Works, Atlanta, Ga.
Tuscarora Fertilizer Co., Chicago, Ill.
Continental Fertilizer Co., Atlanta, Ga.
Jones Fertilizer Co., Nashville, Tenn.

The Plummer Supply Co. and the Agricultural Supply Co., two selling companies shown on the chart, are at the present time inactive. Should they become operative in the future they will be identified in the same manner as the active selling companies.

The Pulaski Fertilizer Co. has been sold and 10 other companies are inoperative and in process of liquidation, as follows:

Boaz Fertilizer Co., Boaz, Ala.
Jackson County Fertilizer Co., Winder, Ga.
Metter Fertilizer Co., Metter, Ga.
Alaga Fertilizer Co., Fort Gaines, Ga.
Griggs Fertilizer Co., Doerun, Ga.
Tri-County Fertilizer Co., Royston, Ga.
Green County Fertilizer Co., Pendergrass, Ga.
Tatnall Fertilizer Co., Hagan, Ga.
Unadilla Fertilizer Co., Unadilla, Ga.
Cartersville Guano Co., Cartersville, Ga.

Number of plants operated.—As the chart shows the Armour Fertilizer Works in 1914 operated directly 17 fertilizer plants, while through the subsidiaries directly controlled it operated 9 plants, and through the subsidiaries indirectly controlled it operated 15 plants, making a total of 41 plants. Table 65 below shows the character and location by States of all these plants.

TABLE 65.—NUMBER AND CHARACTER OF FERTILIZER PLANTS OPERATED BY ARMOUR FERTILIZER WORKS PROPER AND BY SUBSIDIARY COMPANIES, AND TOTALS, BY STATES, 1914.

State.	Armour Fertilizer Works proper.			Subsidiary companies directly controlled.			Subsidiary companies indirectly controlled.		Total.		
	Complete.	Complete except acid chambers.	Dry mixers.	Complete.	Complete except acid chambers.	Dry mixers.	Complete except acid chambers.	Dry mixers.	Complete.	Complete except acid chambers.	Dry mixers.
Georgia	1		1	1		[1]2	1	10	2	1	13
Virginia		1					1	2		2	2
North Carolina		1	1							1	1
Alabama						2					2
Illinois		2								2	
Texas	1		1						1		1
New Jersey	1								1		
Maryland					1					1	
Florida	1								1		
Kentucky						1					1
Tennessee				1					1		
Arkansas								1			1
Louisiana				1					1		
Missouri			1								1
Nebraska			1								1
Iowa			1								1
Kansas			1								1
Colorado			1								1
California			1								1
Total	4	4	9	3	1	5	2	13	7	7	27

[1] One affiliated.

The 41 plants of the Armour Fertilizer Works are scattered over 19 States, extending from New Jersey to Florida and California. Sixteen of these plants are located in Georgia, 4 in Virginia, 2 each in North Carolina, Alabama, Texas, and Illinois, and 1 plant in each of 13 other States. Seven of the plants are complete, 7 complete except acid chambers, and 27 are dry mixers.

Companies controlled through intermediaries.—The Armour Fertilizer Works in 1914 was the beneficial owner of the stock of 9 fertilizer companies shown in the last column of the chart above. In other words, the stock of these concerns was held by intermediary persons connected with the Armour Fertilizer Works for its benefit. Other companies held in a similar manner were Jackson County Fertilizer Co., Winder, Ga., and Metter Fertilizer Co., Metter, Ga., as subsidiaries of the Marietta Fertilizer Co., and Hope Fertilizer Co., Hope, Ark., as subsidiary of the Tennessee Chemical Co., making 12 local subsidiary companies operating 13 dry-mixing plants and 2 wet-mixing plants.

The several companies held by the Armour Fertilizer Works through intermediaries were operated on a profit-sharing basis. A corporation was formed, all of whose stock was owned by representatives of the Armour Fertilizer Works. The plant and machinery were owned by a person who was called the agent, and who usually was well acquainted in his locality. He was allowed a certain rental on the cost of plant and machinery and paid taxes and insurance thereon. He operated the plant, sold the output, was liable for a certain portion of the losses, and was entitled to a share of the net profits. The Armour Fertilizer Works financed the corporation, supplied all the materials at market prices, had general supervision of manufacturing, selling, accounting, and collecting, was liable for a certain portion of the losses, received reasonable interest on funds advanced, and was entitled to a portion of the profits. The corporation declared profits after paying for rental of plant, interest on money invested in stocks, expenses, taxes and insurance, etc., and labor and other necessary expense for the proper conduct of the business. The success of this plan depended largely on the reputation and ability of the local agent. The Armour Fertilizer Works reports that this profit-sharing arrangement did not give the results expected, and for that reason the Pulaski Fertilizer Co., Hawkinsville, Ga., has been sold and the nine other companies in Georgia are in process of dissolution and are not now operated. The Boaz Fertilizer Co., Boaz, Ala., also is in process of dissolution.

Mining properties.—The Armour Fertilizer Works owns phosphate beds in Florida comprising 240 acres, containing deposits of land-pebble rock, and in Tennessee 85 acres, containing deposits of brown-phosphate rock, and 215 acres containing deposits of blue-phosphate rock. Mining operations are carried on only at the Florida beds, where a quantity of rock sufficient to meet about one-third of the annual requirements of the company is obtained.

Section 8. International Agricultural Corporation.

Organization and capitalization.—The International Agricultural Corporation, the fourth of the large fertilizer companies in point of size and output, was incorporated under the laws of New York, June 14, 1909. The leading spirit in the organization of this corporation was Waldemar Schmidtman, of Germany, interested in two German potash mines. An interest in one of these, the Kaliwerke Sollstedt Gewerkschaft, was secured by the International Agricultural Corporation upon its organization. The corporation, in addition to several fertilizer-manufacturing plants, also secured, at the time of incorporation, extensive phosphate properties in Tennessee.

On July 3, 1909, the capital stock of the International Agricultural Corporation was fixed at $15,000,000, divided into $7,500,000 common and $7,500,000 7 per cent preferred. This was increased April, 1911, to $36,000,000, divided equally between the common and preferred.

The amount outstanding June 30, 1914, was $7,303,500 common and $13,055,500 preferred. In addition to the outstanding stock, there is a bonded indebtedness of $12,418,800, 20-year, 5 per cent bonds of an authorized issue of $30,000,000, dated May 1, 1912.

The annual statements to stockholders do not show any item for brands, good will, trade-marks, etc. The largest item of assets appearing in the 1914 balance sheet is $20,965,752.80 for real estate, plants, equipments, etc., the total assets being $38,031,982.30. The phosphate-rock properties constitute nearly one-half of this real estate, plant, etc. account, those owned by the International Agricultural Corporation proper being valued at $3,690,010.87 and those owned by the Florida Mining Co. and the Prairie Pebble Phosphate Co. being valued at $5,850,595.01, making a total of $9,540,605.88. The next largest item of assets is $8,893,944.83, which represents the book value of investments in affiliated companies. The fertilizer and degreasing plants, including peat and marl properties of the International Agricultural Corporation proper, are carried at $2,045,108.31 and those of subsidiaries at $322,218.82.

The International Agricultural Corporation has exclusive contracts, made in 1910, by which it obtains the very large output of sulphuric acid of the Tennessee Copper Co. and the Ducktown Sulphur, Copper & Iron Co., Ltd. This acid is used at all the plants of the International Agricultural Corporation equipped for making acid phosphate or for wet mixing and also by the five acidulating plants owned by affiliated companies. The surplus acid is sold to numerous fertilizer and chemical companies throughout the South. This acid contract was carried on the 1910 balance sheet as an asset at $742,639, but it does not appear in subsequent statements. In fact, the output of acid from these plants increased so rapidly that the International Agricultural Corporation had difficulty in disposing of it, and in 1914 obtained a modification of the contract.

Subsidiary and affiliated fertilizer companies.—The International Agricultural Corporation has a 100 per cent interest in five fertilizer manufacturing companies, of which four are dry mixers and one a wet mixer. Two of the dry mixers are in South Carolina, one in Georgia, and one in Canada. The wet mixer, the Home Mixture Guano Co., operates a plant at Columbus, Ga., and in 1914 owned a stock interest ranging from 100 per cent to 33⅓ per cent in 13 other fertilizer companies operating dry-mixing plants in the State of Georgia.

The Agricultural Investment Corporation, a holding company owned by the International Agricultural Corporation, in 1914 had a stock interest—in most cases 50 per cent—in 30 other fertilizer companies. The International Agricultural Corporation also has three companies engaged exclusively in selling fertilizers under their own brand names which it puts up for them. In the purchase of the plants of at least two other companies (National Fertilizer Co., Nashville, Tenn., and Pioneer Fertilizer Co., Florence, Ala.) the International Agricultural Corporation secured the right to use their brands which have been sold as those of an independent concern.

The corporate organization of the International Agricultural Corporation, together with the location and character of plants in 1914, is shown by the chart facing page 206. In addition to the companies shown on the chart, the International Agricultural Corporation at one time had contracts with 14 independent fertilizer companies, whereby it shared profits on the basis of the materials furnished by each. This arrangement did not prove satisfactory, and most of the contracts have been canceled.

Identification of companies.—The International Agricultural Corporation has volutarily agreed to identify its 100 per cent companies directly controlled by using the words "Branch of International Agricultural Corporation" on their letterheads, contracts, advertising matter, and bags. There are six such companies, viz.:

Chattahoochee Fertilizer Co., Atlanta, Ga.
Seacoast Fertilizer Co., Savannah, Ga.
Greenwood Fertilizer Co., Greenwood, S. C.
Anderson Fertilizer Co., Anderson, S. C.
Home Mixture Guano Co., Columbus, Ga.
Southern Refining Co., Athens, Ga.

The L. W. Hubbell Fertilizer Co., Cincinnati, Ohio., and the Florence Cotton Oil Co., Florence, Ala., two selling companies shown on the chart, will be liquidated. The Dominion Fertilizer Co. (Ltd.), being a Canadian concern located at St. Stephens, is not included in the above list.

All but three of the affiliated companies of the International Agricultural Corporation, in which its interest is held through the Home Mixture Guano Co. and the Agricultural Investment Corporation, will be identified by the words, "International Agricultural Corporation—Shareholding Interest." The companies so identified are as follows:

Companies controlled by or affiliated with Home Mixture Guano Co.:

Fletcher Guano Co., Columbus, Ga.
Dawson Home Mixture Guano Co., Dawson, Ga.
Bullochville Home Mixture Guano Co., Bullochville, Ga.
Cuthbert Home Mixture Guano Co., Cuthbert, Ga.
Reynolds Home Mixture Guano Co., Reynolds, Ga.
Richland Home Mixture Guano Co., Richland, Ga.
Chipley Home Mixture Guano Co., Chipley, Ga.
Lumpkin Home Mixture Guano Co., Lumpkin, Ga.
Shellman Home Mixture Guano Co., Shellman, Ga.
Americus Home Mixture Guano Co., Americus, Ga.

Companies controlled by or affiliated with the Agricultural Investment Corporation:

Catawba Fertilizer Co., Lancaster, S. C.
Congaree Fertilizer Co., Columbia, S. C.
Hartsville Fertilizer Co., Hartsville, S. C.
Montezuma Fertilizer Co., Montezuma, Ga.
Altamaha Fertilizer Co., Vidalia, Ga.
Cherokee Fertilizer Co., Macon, Ga.
The Cumberland Fertilizer Co., Cartersville, Ga.
The Davisboro Fertilizer Co., Davisboro, Ga.
Decatur Fertilizer Co., Decatur, Ala.
Dodge Fertilizer Co., Eastman, Ga.
Farmers' Fertilizer Co., Milan, Ga.
Improved Guano Co., Eastman, Ga.
Lawrenceville Fertilizer Co., Lawrenceville, Ga.
Millen Fertilizer Co., Millen, Ga.
Oconee Fertilizer Co., Dublin, Ga.
Orangeburg Fertilizer Co., Orangeburg, S. C.
Osceola Fertilizer Co., Jacksonville, Fla.
Peoples' Fertilizer Co., Bay Minette, Ala.
The Planters' Fertilizer Co., Tennille, Ga.
Soperton Guano Co., Soperton, Ga.
Swainsboro Fertilizer Co., Swainsboro, Ga.
Union Fertilizer Co., Cullman, Ala.
Union Springs Guano Co., Union Springs, Ala.
[1] Rainbow Guano Co., Montgomery, Ala.

The Abbot Manufacturing Co., Louisville, Ga.; Buena Vista Home Mixture Guano Co., Buena Vista, Ga.; and Ellaville Guano Co., Ellaville, Ga., at the time of going to press had not decided to adopt this identification.

Several companies shown on the chart have been liquidated or sold or are no longer in operation. These are as follows:

West Point Home Mixture Guano Co., West Point, Ga.
The Chatsworth Guano Co., Chatsworth, Ga.
Elmore Fertilizer Co., Tallassee, Ala.
Georgia Fertilizer Works, Sandersville, Ga.
So. Alabama Fertilizer Co., Sampson, Ala.
Vance Guano Co., Henderson, N. C.

Number of plants operated.—As the chart shows, the total number of fertilizer plants operated by the International Agricultural Corporation in 1914 was 64, of which 15 were operated directly, 5 through subsidiaries, and 44 through affiliated companies. Of the total number 19 were acidulating plants and 45 were dry mixers. Table 66 below shows the character and location by States of all these plants.

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[1] A controlling interest in this company, which has a capital stock of $50,000, has been recently acquired.

SWAINSBORO FERTILIZER C
Swainsboro, Ga.
Cap. Stock $45,000.
A.I.C. owns 50%

UNION FERTILIZER CO.
Cullman, Ala.
Cap. Stock $20,000.
A.I.C. owns 50%

UNION SPRINGS GUANO CO
Union Springs, Ala.
Cap. Stock $40,000.
A.I.C. owns 50%

VANCE GUANO CO.
Henderson, N.C.
Cap. Stock $30,000.
A.I.C. owns 80%

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TABLE 66.—NUMBER AND CHARACTER OF FERTILIZER PLANTS OPERATED BY THE INTERNATIONAL AGRICULTURAL CORPORATION PROPER AND BY SUBSIDIARY AND AFFILIATED COMPANIES, AND TOTALS, BY STATES, 1914.

State.	International Agricultural Corporation proper.		Subsidiary companies.		Affiliated companies.		Total.	
	Complete except acid chambers.[1]	Dry mixers.	Complete except acid chambers.[1]	Dry mixers.	Complete except acid chambers.[1]	Dry mixers.	Complete except acid chambers.[1]	Dry mixers.
Georgia	7		1	1	2	30	10	31
Alabama	2					6	2	6
South Carolina	1			2	3	1	4	3
Florida						1		1
Tennessee	1						1	
North Carolina						1		1
Ohio	1						1	
New York	1	1					1	1
Maine		1						1
Total United States	13	2	1	3	5	39	19	44
Canada				1				1

[1] Some of these plants have acid chambers but not operating, their requirements of sulphuric acid being obtained from the two Tennessee copper companies.

Of the 15 fertilizer plants operated by the International Agricultural Corporation proper, 13 are acidulating plants and 2 dry mixers. Seven acidulating plants are located in Georgia, 2 in Alabama, and 1 each in South Carolina, Tennessee, Ohio, and New York. The 2 dry mixers are located in New York and Maine. Included in the above are 3 large plants in Georgia leased in June, 1914, by the International Agricultural Corporation for a term of years, one at Albany from the Tennessee Fertilizer Co., one at Columbus from the Georgia Fertilizer Co., and the other at Macon from the Cotton States Seed & Fertilizer Co., the lease from the last-named company being subsequently given up. The five plants of subsidiaries are located in Georgia, South Carolina, and Canada. The 44 plants of the affiliated companies are located mostly in Georgia and other Southern States.

Phosphate-mining properties.—Since its organization the International Agricultural Corporation has acquired valuable phosphate-rock deposits in Florida and additional holdings in Tennessee. The Florida holdings consist of about 39,000 acres located in Polk, Hillsboro, and De Soto Counties, formerly owned by the Prairie Pebble Phosphate Co., and 3,300 acres in Polk County, formerly owned by the Florida Mining Co.[1] In 1910 the International Agricultural Corporation acquired the capital stock of these two concerns and later took over their holdings of phosphate lands and other real estate in fee simple. On about 13,000 acres of the Prairie Pebble lands the company estimates that there are more than 30,000,000 long tons of pebble-phosphate rock. The remaining lands have not been wholly prospected, but are known to contain some phosphate rock. On 1,500 acres of the Florida Mining Co.'s lands the company estimates that there are more than 7,000,000 long tons of high-grade, land pebble-phosphate rock. The Florida properties are now operated under lease by the Prairie Pebble Phosphate Co. and the Florida Mining Co., subsidiaries of the International Agricultural Corporation. There are altogether 8 mining stations and washing plants, 33 miles of electric railroad, and 2 central drying plants.

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[1] Of the total acreage 42,300 the company reports 15,300 as prospected land and 19,280 as unprospected, leaving about 7,700 acres unaccounted for.

The Prairie Pebble Phosphate Co. is a Georgia corporation, and at the time of its acquisition by the International Agricultural Corporation had a capital stock outstanding of $1,380,000 and bonded indebtedness of $1,846,000. The capital stock of the Prairie Pebble Phosphate Co. was owned by the Atlas Phosphate Co. which was acquired by the International Agricultural Corporation in 1910.

In Tennessee the International Agricultural Corporation owns phosphate properties comprising 5,324 acres, estimated by the company to contain more than 6,500,000 tons of brown phosphate rock and 6,000,000 tons of blue rock. The company also owns 96.4 per cent of the capital stock of the Independent Phosphate Co., with holdings comprising 2,103 acres of land, on 753 acres of which are brown rock deposits estimated by the company to contain 105,000 tons and on 1,350 acres are blue rock deposits estimated to contain 7,500,000 tons. There are eight mining stations on these properties.

Potash properties.—The International Agricultural Corporation in June, 1909, became the owner of the entire capital stock of the Kaliwerke Sollstedt Gewerkschaft, a German corporation, owning a potash mine and a large factory for concentrating potash salts into commercial forms at Sollstedt, Germany. The mine is estimated to contain 50,000,000 tons of potash, or more than 50 times the present annual consumption of the United States. Following the enactment of the German potash law in 1910 (see p. 110), the International Agricultural Corporation sold one-half interest in the Sollstedt mine to the Kaliwerke Aschersleben and, as a part of the transaction, gave that company an option to purchase the remaining half at any time up to December 31, 1916, for $1,488,000 cash. If this option is exercised, the International Agricultural Corporation will be obligated to take over at par $1,000,000 of International stock now in Sollstedt's treasury. If not exercised by December 31, 1916, the International Agricultural Corporation will be obligated to take over this stock for cash at par by February 15, 1917.

Section 9. F. S. Royster Guano Co.

Organization and capitalization.—The F. S. Royster Guano Co., Norfolk, Va., is a close corporation organized under the laws of Virginia in July, 1900. This company ranked fourth in 1913 in point of output of bagged goods. The capital stock authorized and outstanding is $2,500,000, consisting of $1,000,000 common and $1,500,000 preferred. There is no bonded indebtedness. The company proper operates nine fertilizer plants, all of which it has built. These plants are as follows: Five complete plants located at Baltimore, Md., Norfolk, Va., Charlotte, N. C., Columbia, S. C., and Macon, Ga., four dry mixers located at Tarboro, N. C., Spartanburg, S. C., Columbus, Ga., and Montgomery, Ala.

The F. S. Royster Guano Co. in 1914 had four subsidiary selling companies—Columbia Guano Co., Atlantic Chemical Corporation, Muscogee Guano Co., and Old Buck Guano Co., and one affiliated dry-mixing concern, the Pamlico Chemical Co., a Virginia corporation organized in 1914 to take over the property of the Pamlico Chemical Co. of North Carolina, in which the Virginia-Carolina Chemical Co. had an interest. Hereafter the first three selling companies will be identified by the use of the words "Subsidiary of F. S. Royster Guano Co." The stock of the Old Buck Guano Co., a Richmond concern acquired in 1914, will be increased from $10,000 to $20,000, $12,500 of this stock, or a majority interest, to be held by W. E. Barrett, its president. The stock of the Pamlico Chemical Co., of which the F. S. Royster Guano Co. owns 51 per cent, will be increased from $135,000 to $155,000 and the $20,000 additional stock returned to the present minority stockholders, so that they will be in control of the company.

The F. S. Royster Guano Co. also has four other subsidiaries engaged in other business than manufacturing and selling fertilizers: (1) Consumers' Cotton Oil Co., Tarboro, N. C.; (2) F. S. Royster Guano Co. of North Carolina, organized for the purpose of holding real estate in North Carolina; (3) National Utilization Co., Norfolk, Va., which owns American rights to a German process for converting insoluble ammonia in waste products into soluble form, the capital stock of which ($10,000) is owned by the Columbia Guano Co.; and (4) Florida Phosphate Mining Co., incorporated in 1907 in Virginia with a capital stock of $500,000, all owned by F. S. Royster Guano Co., which operates mines and a washing plant at Bartow, Polk County, Fla. This company owns extensive beds of Florida pebble phosphate rock, estimated to contain a sufficient quantity to meet the requirements of the company for 40 years.

Section 10. Swift & Co.

The Swift fertilizer business is now conducted largely under the name of Swift & Co. In December, 1913, Swift & Co., of Illinois, took over the business and property of the Atlantic Fertilizer Co.

with a wet-mixing plant at Baltimore, Md., now operated as Swift & Co.-Atlantic Fertilizer Works, and also the business and property of the Swift Fertilizer Works, of Atlanta, Ga., with complete plants at Atlanta, Ga., and Wilmington, N. C.; one complete plant, except acid chambers, at Albany, Ga., and dry mixers located at Savannah, Ga., and Chester and Columbia, S. C. On December 27, 1913, Swift & Co., of Illinois, took over the fertilizer business of Swift & Co. (Ltd.), with a complete plant, except acid chambers, at Harvey, La., and a dry mixer at Shreveport, La.

Swift & Co. in 1914 operated a total of 19 fertilizer plants, located in 13 different States, as follows:

Two complete, with acid chambers, at Wilmington, N. C., and Atlanta, Ga.

Six complete, except acid chambers, at Chicago, Ill.; East St. Louis, Ill.; Baltimore, Md.; Albany, Ga.; Cleveland, Ohio; and Harvey, La.

Eleven dry mixers at Savannah and Moultrie, Ga.; Chester and Columbia S. C., Kansas City, Kans.; Shreveport, La.; South St. Paul, Minn.; South St. Joseph, Mo.; South Omaha, Nebr.; Harrison, N. J.; Fort Worth, Tex.

The Cotton States Fertilizer Works, Atlanta, Ga., is operated as a selling company, but the stationery, contracts, and fertilizer containers show the company to be owned and the fertilizer to be put up by Swift & Co.

Swift & Co. own the State Phosphate Co., which was incorporated under the laws of West Virginia with a capital stock of $100,000. The State Phosphate Co. owned beds of pebble-phosphate lands comprising 2,329 acres, estimated to contain 1,645,000 tons, and operated a mining station, washing plant, etc., at Bartow, Fla. The business of this company was taken over by Swift & Co., of Illinois, on December 27, 1913. Swift & Co. also own in fee 374 acres of phosphate lands in Tennessee and, in addition, mineral rights to 362 acres. The quantity of rock contained in the Tennessee deposits has never been proved up.

Swift interests control the Consolidated Rendering Co., a Maine corporation, with a capital stock of $1,500,000, authorized and issued, with general offices at Boston, Mass. E. F. Swift is vice president of Swift & Co. and president of the Consolidated Rendering Co. The latter concern is engaged in the business of rendering, wool pulling, etc., and produces grease, tallow, oleo oil, glue, fertilizers, etc., at many points, extending from Syracuse, N. Y., to Windsor, Nova Scotia. The importance of this concern in the fertilizer industry is best indicated by the total sales of bagged goods, which in the 1914 season amounted to nearly 67,000 tons and in 1913 to nearly 55,000 tons, of which ammoniated goods constituted about 59,000 and 48,000 tons, respectively. The following concerns manufacture or mix fertilizers, in most cases in connection with a rendering business:

Lowell Fertilizer Co., Lowell, Mass.
Syracuse Rendering Co., Syracuse, N. Y.

Burlington Rendering Co., Burlington, Vt.
New Haven Rendering Co., New Haven, Conn.
Springfield Rendering Co., Springfield, Mass.
Worcester Rendering Co., Auburn, Mass.
Portland Rendering Co., Portland, Me.
Pawtucket Rendering Co., Pawtucket, R. I.
Manchester Rendering Co., Manchester, N. H.
Colonial Fertilizer Co., Windsor, Nova Scotia.

The Lowell Fertilizer Co. has a wet mixing plant, while the other nine concerns are dry mixers.

In addition to these concerns operating plants the company has five selling companies without plants, viz:

Atlantic Packing Co., Boston, Mass.
Essex Fertilizer Co., Boston, Mass.
New England Fertilizer Co., Boston, Mass.
Parmenter & Posley Fertilizer Co., Boston, Mass.
L. T. Frisbie Co., New Haven, Conn.

The company reports that none of the above-named concerns is incorporated, but they are simply used as trade names in handling the product. The business of the Lowell Fertilizer Co. has also been conducted under the name of Lowell Fertilizer Co. and Swift-Lowell Fertilizer Co. The word "Swift" was dropped several years ago.

The Consolidated Rendering Co. has voluntarily agreed to identify all of the above companies by using the words "Branch of Consolidated Rendering Co." on their letterheads, stationery, contracts, bags, etc.

Section 11. Baugh & Sons Companies.

There are three separate Baugh corporations engaged in manufacturing or selling fertilizers, the capital stocks of which aggregate $2,000,000, and are owned by the same individuals. The manufacturing companies are Baugh & Sons Co., of Philadelphia, Pa., with plants at Philadelphia, Pa., and Norfolk, Va.; and the Baugh Chemical Co. of Baltimore County, with a large manufacturing plant equipped with acid chambers at Baltimore, Md. The former is one of the oldest fertilizer concerns in the United States, and the latter is a very large manufacturer of acid phosphate. The third corporation, Baugh & Sons Co. of Baltimore city, is the selling company for the two other companies. The Baugh companies have never organized or acquired an interest in other fertilizer companies. All of their fertilizers are sold under the name "Baugh."

Baugh & Sons Co., of Philadelphia, as already noted (see p. 191), in 1914 had a stock interest in the Amalgamated Phosphate Co., engaged in mining Florida pebble phosphate rock in Polk County, Fla. In addition to its fertilizer business it is engaged in rendering, degreasing, etc., and also operates a bone-carbonizing plant, producing a considerable quantity of sulphate of ammonia annually.

Section 12. Other important companies.

In addition to the seven large companies above discussed, there are three companies whose output in 1913 was in excess of 75,000 tons and less than 100,000 tons. The Read Phosphate Co., Nashville, Tenn., is a West Virginia corporation organized in 1898 and has a capital stock of $750,000, all but a few shares of which are owned by the Read family. It has complete plants with acid chambers at Nashville, Tenn., and Charleston, S. C., and a wet-mixing plant at Cordele, Ga. It also controls the Hopkins Fertilizer Co., a dry mixer, located at New Albany, Ind., and the Independent Packers' Fertilizer Co., a wet mixer located at Columbus, Ohio. The company is also interested in the Planters' Guano Co., a small dry mixer at Lilly, Ga. The parent company operates three selling companies—the Empire Guano Co., St. Bernard Fertilizer Co., and Victor Guano Co., all of Nashville, Tenn. These companies have been advertised as independents. The Independent Packers' Fertilizer Co. has one subsidiary selling company, the Welch Fertilizer Co., Columbus, Ohio, which is not now active.

The Read Phosphate Co. has voluntarily agreed to identify its three selling companies by using the words "Subsidiary of Read Phosphate Co." on their letterheads, stationery, contracts, bags, etc., but has not agreed to identify the Hopkins Fertilizer Co. and the Independent Packers' Fertilizer Co., in each of which the Read Phosphate Co. has a 51 per cent interest. It is stated that these two companies have been operated independently of, and in a territory not covered by, the Read Phosphate Co.

The Meridian Fertilizer Factory, Meridian, Miss., a Mississippi corporation, was organized in 1884 and has a capitalization of $880,000 and bonded indebtedness of $200,000. The company has three complete plants, located at Meridian and Hattiesburg, Miss., and Shreveport, La. The company also operates a cotton-oil mill at Hattiesburg, Miss.

The American Cotton Oil Co., the corporate organization of which is discussed in Chapter III, page 61, mixes and sells fertilizers at 15 of its 36 active cotton-oil mills. The fertilizer business is conducted by its subsidiary, The Union Seed & Fertilizer Co., which also operates a complete plant at Gretna, near New Orleans, as successor to New Orleans Acid and Fertilizer Co. and a dry mixer at Jackson, Miss., as successor to the Capital Fertilizer Manufacturing Co. In 1913 the American Cotton Oil Co. also operated a dry mixing plant at Latta, S. C., under the name of Latta Gin & Manufacturing Co.

In the Middle West there are three important manufacturers of fertilizers other than those already mentioned whose output of bagged goods alone ranged between 40,000 and 60,000 tons in 1913, as follows: The Smith Agricultural Chemical Co., Columbus, Ohio, with complete plants at Columbus, Ohio, and Indianapolis, Ind.; The Jarecki Chemical Co., Cincinnati, Ohio, with complete plants at Cincinnati and Sandusky, Ohio; and Federal Chemical Co., with a large complete plant at Louisville, Ky. The Jarecki Chemical Co. has three subsidiary selling companies—The Packers' Fertilizer Co., The Kaufman Fertilizer Co., and The Cincinnati Phosphate Co.—which it has voluntarily agreed to identify by using the words "Branch of The Jarecki Chemical Co." on their letterheads, advertising matter, contracts, bags, etc. The Federal Chemical Co. has three subsidiary selling companies—Globe Fertilizer Co., Fox Chemical Co., and Kentucky Fertilizer Co.—which it identifies as branches of the Federal Chemical Co. The Federal Chemical Co. is also an important miner of Tennessee brown rock and, in addition to its mixed fertilizer business, sells a large tonnage of ground rock for direct application to the soil. The sales of bagged goods by these three companies were more than 145,000 tons in the 1913 season.

At Philadelphia the I. P. Thomas & Son Co. and F. W. Tunnell & Co. (Inc.) are important manufacturers, and at Baltimore, in addition to the plants of the large companies already considered, there are several important concerns, viz, the Miller Fertilizer Co.; G. Ober & Sons Co. of Baltimore City; Griffith & Boyd Co.; The Hubbard Fertilizer Co.; and the Piedmont Mt. Airy Guano Co. There are also a number of smaller concerns. The Hubbard Fertilizer Co. has one selling company, the Chesapeake Chemical Co., which it has agreed to identify or dissolve.

In the States of Virginia and North Carolina the Caraleigh Phosphate & Fertilizer Works, Raleigh, N. C., together with its allied companies, Farmers' Guano Co., Norfolk, Va., and the Farmers' Cotton Oil Co., Wilson, N. C., all owned by the same interests, has a larger output than any of the companies except those discussed above. The Farmers' Guano Co. has one selling company, the R. L. Upshur Guano Co., which is also used by the Caraleigh Phosphate & Fertilizer Works. The Farmers' Guano Co. has voluntarily agreed to identify this company by using the words "Branch of Farmers' Guano Co." on its letterheads, advertising matter, contracts, bags, etc. The Acme Manufacturing Co., Wilmington, N. C., ranks next in importance with an output of about 40,000 tons. The Richmond Guano Co., Richmond, Va., has two unincorporated selling companies—Powhatan Fertilizer Co. and Venable Fertilizer Co.—which it has voluntarily agreed to identify by using the words "Subsidiary of Richmond Guano Co." on their letterheads, advertising matter, contracts, bags, etc.

There are three large independent companies at Charleston, S. C., Planters' Fertilizer & Phosphate Co., Etiwan Fertilizer Co., and the

Combahee Fertilizer Co., whose combined sales of bagged goods in 1913 exceeded 106,000 tons. A fourth concern, the Molony & Carter Co., also handles feedstuffs. It has a dry-mixing plant and handles not only mixed fertilizers, but sells large quantities of fertilizer materials to truckers in the vicinity of Charleston. The headquarters of the Interstate Chemical Corporation are also located at Charleston. The company has plants at Charleston, S. C.; Tampa, Fla.; Macon, Ga.; Greenwood, S. C.; and Charlotte, N. C., which have been idle for several years.

Georgia, the largest consumer of fertilizers, has comparatively few large companies other than the seven principal ones. At Savannah, Wilcox, Ives & Co., Reliance Fertilizer Co., and the Mutual Fertilizer Co. are probably the most important, their combined output of bagged goods in 1913 being more than 106,000 tons. Robert S. Cope, president of the Reliance Fertilizer Co., is also second vice president and general manager of the Barker Chemical Co., which has a large complete plant at Inglis, Fla. The Phosphate Mining Co. has a large plant at Savannah devoted to the manufacture of acid phosphate. The Southern States Phosphate & Fertilizer Co., Augusta; Empire Cotton Oil Co., Morris Fertilizer Co., and Furman Farm Improvement Co., of Atlanta, including the Chickamauga Fertilizer Co., Chattanooga, Tenn., owned by same interests as the latter, and the Empire State Chemical Co., Athens, are the other leading companies in Georgia. The combined output of bagged goods of these five companies in 1913 was more than 150,000 tons. The Morris Fertilizer Co. operates a selling company, the South Atlantic Guano Co., which it has agreed to identify by using the words "Subsidiary of Morris Fertilizer Co." on its letterheads, contracts, bags, etc.

The largest independent company in Florida is the Wilson & Toomer Fertilizer Co., at Jacksonville. The E. O. Painter Fertilizer Co. is next in importance.

In Alabama there are four important companies—the Alabama Chemical Co., Montgomery, with its affiliated company, Dothan Chemical Co., Dothan; The Grasselli Chemical Co., with four plants, located at Dothan, Grasselli, Gadsden, and Selma; Jefferson Fertilizer Co., Birmingham; and Standard Chemical & Oil Co., Troy. These four concerns sold more than 115,000 tons of bagged goods in 1913.

Section 13. Selling methods of principal companies.

The middleman.—Probably 80 per cent of the output of the larger fertilizer manufacturers is distributed to the farmer through middlemen. The smaller dry-mixing concerns whose business is local generally deal with the farmer directly. In the South the country storekeepers usually sell fertilizers, while in the North farmers, implement, coal, produce, and other dealers handle this business. In recent years the tendency of the large fertilizer manufacturers in certain sections of the South has been to sell directly to farmers, particularly to those of good credit, who are able to buy in carload lots. Direct sales are most common in Georgia, owing to the fact that in certain localities the farmers buy in large quantities and the merchants no longer handle fertilizer on account of the competition of the local dry mixers. The direct sales of the larger manufacturers in Georgia probably amount to about 20 per cent, while those of all concerns, including the large number of dry mixers, amount to about 60 per cent.

Sales to middlemen and also to farmers directly are usually made through the aid of traveling salesmen who work on salary, although most companies also employ commission men to solicit orders. In the cotton States these agents begin operations about the first of the year. In the wheat sections of the North the fall trade as well as the spring trade is solicited.

Credit conditions.—It is estimated that from 80 to 90 per cent of the sales of fertilizer manufacturers in the cotton States are made on credit, while in the North only from 15 to 25 per cent of the sales are made on this basis. Where purchases are not paid for in cash on settlement date, the manufacturers take the dealers' and farmers' notes as security, which call for payment at a later date, known as the "due" date. The settlement date in the cotton States is May 1. The collection of the notes given at this time by dealers as security for credit sales are made from October 15 to December 1. The notes do not bear interest, since the prices are time prices. In the North there are two settlement dates. The one for fall deliveries is usually December 1 or January 1, and the one for spring deliveries is June 1 or July 1. The notes given on these dates, as a rule, bear interest at the rate of 6 per cent. The collection dates come in the autumn months after the crops on which the fertilizer was used have been harvested.

The general practice of fertilizer companies is to allow a discount for cash on the settlement date and a further discount for cash prior to settlement date. There is a considerable saving to the purchaser, therefore, if he pays cash. The high interest rates on agricultural credits, however, sometimes make it to the advantage of the farmer to buy his fertilizer on credit and use his cash for other purposes.

Price basis.—The fertilizer salesman is usually provided with a list of so-called base prices for the different formulas which he sells. The Virginia-Carolina Chemical Co. for each spring season issues printed price lists for the States of Virginia, North Carolina, South Carolina, Georgia, and Alabama, which contain the base prices for the various formulas and materials sold. These list prices are adopted by practically every other fertilizer concern doing business in these States. The Virginia-Carolina Chemical Co. states that it does not distribute these price lists to competitors unless requested, but the prices are easily obtainable from merchants who are visited by the Virginia-Carolina salesmen. Competitors of the Virginia-Carolina give as reasons for following the latter's list price that if their own list prices were higher they could not sell any fertilizers, and if they were lower they would be met by concessions from the Virginia-Carolina, so they usually wait until the Virginia-Carolina salesmen start out and then follow their prices.

In the North the prices of The American Agricultural Chemical Co. are quite generally followed by other companies.

Terms of contracts.—The consignment contract which is generally employed in both the North and the South for sales to dealers provides that the manufacturer shall retain title to the goods until paid for and that the dealer shall guarantee the payment of all sales in full, shall give his note for amounts unpaid on settlement date, and shall deliver to the manufacturer all notes, accounts, etc., taken from farmers in payment for fertilizer as collateral to secure his own note. For instance, the contract of the F. S. Royster Guano Co., which is representative of this form of contract, contains the following clause:

> And it is distinctly understood and agreed that all of the above fertilizers to be consigned to you, as herein provided, remain our property and are at all times subject to our order until sold by you as our agent, and that after sale by you the cash, notes, accounts, or other proceeds of sale are our property, and are to be accounted for by you as such, and you relinquish and assign to us all your interest in any lien, mortgage, or account taken by or due you for goods sold or money loaned to parties who have purchased any of the above fertilizers from you until the amount due us for said fertilizers is fully paid.

Where goods are sold on commission such clauses are, of course, unnecessary. One reason for using this form of contract is that competition among manufacturers has resulted in placing goods with middlemen of uncertain credit. The manufacturers prefer to take back any goods unsold rather than to take the risk of being unable to collect from some of the middlemen.

The price lists or contracts of almost all companies provide for the same discounts and allowances to dealers. A discount of 5 per cent is offered for cash on settlement date and a further discount at the rate of 6 or 7 per cent per annum if payment is made prior to settlement date. A quantity or trade discount of 5 per cent is also frequently allowed dealers who handle a certain quantity of fertilizers. The minimum quantity specified is usually 40 tons, although in some cases it has been reduced to as low as 15 tons. In addition to these regular discounts certain concessions or allowances are generally made to meet competition.

Clauses relating to these special discounts and allowances are sometimes included in the fertilizer contract, but more often such clauses are attached as riders or made a matter of separate agreement and record. The concessions allowed vary greatly, depending upon the policy of the competing companies. These allowances in the South run from 50 cents to as high as $2 a ton. Some companies allow only small concessions, while others agree to meet the concessions of their competitors. For example, a contract of one concern in 1913 contained the following rider:

> Referring to attached contract made this January 17, 1913, between the seller, * * * and buyer, it is mutually agreed that should lower prices be named on the same grade of goods by a reliable and reputable concern, and buyer will submit same to seller in writing, and if desired by seller, give name of party making the offer, and brand or kind of goods, seller will either meet them or permit buyer to cancel the unfilled portion of this contract. However, this will not affect the price of any goods that may have been shipped or delivered on this contract prior to said notice.

Some companies, while not agreeing to meet the concessions of competitors, permit the buyer to cancel the contract if they do not wish to meet the prices of competitors.

Other clauses common to most contracts are (1) that the manufacturer reserves the right to cancel the contract in whole or in part in case of any occurrence regarded as unfavorable to the dealer's credit, or in case of an unavoidable accident preventing the delivery of goods, and (2) that the manufacturer agrees to furnish all fertilizers shipped with a guaranty of analysis on the sack, but not of results from its use.

Operation of subsidiary and affiliated companies.—As has been shown in preceding sections, most of the larger fertilizer manufacturers have adopted the plan of operating controlled companies as independents, mainly in order to secure the services of more dealers and thereby to increase their sales and distribute their credit risks. To remove the criticisms to which this practice was open practically all of the companies known to be operating subsidiary and affiliated companies as independents have voluntarily agreed to identify them by the use of suitable phraseology on their letterheads, advertising matter, contracts, bags, etc., so that it will be possible hereafter for State fertilizer officials, dealers, and farmers to know with whom they are really dealing. If the large companies find that the operation of selling companies with identity disclosed is not profitable, they will withdraw these companies and devote their efforts to pushing their own lines. The policy of acquiring local concerns often has not proven successful, and these concerns are gradually being given up. Thus the fictitious competition that heretofore has existed in the industry will be eliminated and the business restored to a normal basis. More attention will be paid hereafter to quality, because it will no longer be possible to sell a farmer who is dissatisfied the same goods under another name.

Multiplication of brands.—The practice of the large fertilizer companies in doing business through subsidiary and affiliated companies is accompanied by the practice of multiplying the number of brands offered for sale, except where restrained by State laws, far beyond the reasonable requirements of the business. Table 67 shows to what extent this practice of multiplying brands has been carried in the four Southern States, as compared with four Northern States. The number of brands registered by the large companies in their own names is given separately from the number registered by their subsidiary and affiliated companies.

TABLE 67.—NUMBER OF BRANDS REGISTERED BY FERTILIZER MANUFACTURERS IN FOUR NORTHERN STATES IN 1913 SEASON AND IN FOUR SOUTHERN STATES IN 1914 SEASON.

Company.	Northern States.							
	Pennsylvania.		New Jersey.		New York.		Ohio.	
	Number.	Per cent of total.	Number.	Per cent of total.	Number.	Per cent of total.	Number.	Per cent of total.
Virginia-Carolina Chemical Co.—total	66	4.6	43	3.0	41	3.6	39	4.7
Virginia-Carolina Chemical Co., proper	22	1.5	10	.7	......	......	28	3.4
Subsidiaries	44	3.1	33	2.3	41	3.6	11	1.3
The American Agricultural Chemical Co.—total	586	40.5	594	41.9	459	40.7	168	20.3
The American Agricultural Chemical Co., proper	303	20.9	355	25.0	259	23.0	115	13.9
Subsidiaries	283	19.6	239	16.9	200	17.7	53	6.4
Armour Fertilizer Works—total	41	2.8	35	2.5	54	4.8	55	6.7
Armour Fertilizer Works, proper	28	1.9	30	2.1	35	3.1	28	3.4
Subsidiaries	13	.9	5	.4	19	1.7	27	3.3
International Agricultural Corporation—total	26	1.8	......	......	38	3.4	33	4.0
International Agricultural Corporation, proper	26	1.8	......	......	38	3.4	20	2.4
Subsidiaries	......	......	......	......	......	......	13	1.6
F. S. Royster Guano Co.—total	54	3.7	53	3.7	61	5.4	......	......
F. S. Royster Guano Co., proper	37	2.5	31	2.2	42	3.7	......	......
Subsidiaries	17	1.2	22	1.5	19	1.7	......	......
Swift & Co	24	1.7	58	4.1	40	3.5	30	3.6
Baugh & Sons Co	33	2.3	35	2.5	21	1.9	......	......
Total brands, 7 large concerns	830	57.4	818	57.7	714	63.3	325	39.3
Total brands, other concerns	616	42.6	600	42.3	414	36.7	[1] 501	60.7
Total registered brands.	1,446	100.0	1,418	100.0	1,128	100.0	826	100.0

[1] Included in this number are Federal Chemical Co., 28 brands; Jarecki Chemical Co., 42 brands; Smith Agricultural Chemical Co., 58 brands; total, 128 brands.

TABLE 67.—NUMBER OF BRANDS REGISTERED BY FERTILIZER MANUFACTURERS IN FOUR NORTHERN STATES IN 1913 SEASON AND IN FOUR SOUTHERN STATES IN 1914 SEASON—Continued.

Company.	Southern States.							
	Georgia.		South Carolina.		North Carolina.		Alabama.	
	Number.	Per cent of total.	Number.	Per cent of total.	Number.	Per cent of total.	Number.	Per cent of total.
Virginia-Carolina Chemical Co.—total	999	11.7	1,248	23.5	637	20.3	341	18.1
Virginia-Carolina Chemical Co., proper	289	3.4	623	11.7	402	12.8	98	5.2
Subsidiaries	473	5.5	544	10.3	193	6.2	161	8.6
Affiliated companies	237	2.8	81	1.5	42	1.3	82	4.3
The American Agricultural Chemical Co.—total	212	2.5	764	14.4	527	16.8	126	6.7
The American Agricultural Chemical Co., proper	71	.8	212	4.0	198	6.3	123	6.5
Subsidiaries	141	1.7	552	10.4	329	10.5	3	.2
Armour Fertilizer Works—total	977	11.4	317	6.0	115	3.7	63	3.3
Armour Fertilizer Works, proper	244	2.8	152	2.9	95	3.0	23	1.2
Subsidiaries	733	8.6	165	3.1	20	.7	[1] 40	2.1
International Agricultural Corporation—total	884	10.3	228	4.3	44	1.4	117	6.2
International Agricultural Corporation, proper	66	.7	....	....	....	....	17	.9
Subsidiaries	118	1.4	45	.9	....	....	29	1.5
Affiliated companies	700	8.2	183	3.4	44	1.4	71	3.8
F. S. Royster Guano Co.—total	160	1.9	175	3.3	192	6.1	56	3.0
F. S. Royster Guano Co., proper	76	.9	71	1.3	86	2.7	29	1.6
Subsidiaries	84	1.0	104	2.0	106	3.4	27	1.4
Swift & Co	194	2.3	162	3.0	85	2.7	42	2.2
Baugh & Sons Co	56	.6	38	.7	42	1.4	....	....
Total brands, 7 large concerns	3,482	40.7	2,932	55.2	1,642	52.4	745	39.5
Total brands, other concerns	5,078	59.3	2,379	44.8	1,491	47.6	1,139	60.5
Total registered brands	8,560	100.0	5,311	100.0	3,133	100.0	1,884	100.0

[1] Includes brands registered by one affiliated company.

The number of brands registered by fertilizer companies in the four Southern States greatly exceeds the number of registrations in the Northern States. This is due to the larger number of companies engaged in the business and the lack of restriction in regard to the number of brands. The total number of brands registered in the four Northern States in 1913 was 4,818, as against 18,888 for the four Southern States in 1914. Formerly, in New York State, some 2,500 different brands were registered annually, but since a tax of $20 per brand was imposed by law the number has been reduced to 1,128 in 1913, or more than 50 per cent. The number of brands registered in

Alabama, which imposes a tax of $5 for each brand registered, is less than in the other Southern States shown, which impose only a tonnage tax. For instance, in 1914 Alabama had only 1,884 registrations, as against 8,560 for Georgia, 5,311 for South Carolina, and 3,133 for North Carolina.

The table shows that in many cases the number of brands registered by the five largest companies under their own names is less than the number registered by their subsidiaries and affiliated companies. For example, in Georgia the International Agricultural Corporation registered 66 brands under its own name, while its subsidiaries registered 118 brands and its affiliated companies 700. Likewise, the Armour Fertilizer Works registered 244 brands in its own name, while its subsidiaries registered 733 brands.

The seven large companies registered more than 50 per cent of the total brands in five of the eight States shown, and The American Agricultural Chemical Co. registered more than 40 per cent of the brands in the three most important Northern States—Pennsylvania, New York, and New Jersey. In Georgia the number of brands registered by the Virginia-Carolina Chemical Co. was 11.7 per cent, as compared with 11.4 per cent for the Armour Fertilizer Works, 10.3 per cent for the International Agricultural Corporation, and 2.5 per cent for The American Agricultural Chemical Co.

The multiplication of brands in the manner described is accomplished by registering a considerable number of exactly the same formula as well as by increasing the number of formulas. In the State of South Carolina, for instance, there was a total of 290 brands of 8–3–3 goods registered by all companies in the 1913–14 season. Table 68 shows the number of brands of eight different formulas registered by seven large companies and their subsidiary and affiliated companies in South Carolina in the 1913–14 season, as compared with the total number of brands registered.

TABLE 68.—NUMBER OF BRANDS OF CERTAIN FORMULAS REGISTERED IN STATE OF SOUTH CAROLINA BY SEVEN LARGEST COMPANIES, 1913–14 SEASON.

Companies.	Formulas.							
	8–3–3	8–4–4	8–2½–1	9–2–2	9–2–3	9–3–3	10–2–2	10–4–4
Virginia-Carolina Chemical Co.—total	74	70	39	55	17	13	15	9
Virginia-Carolina Chemical Co., proper	41	41	28	51	1	1	3	1
Subsidiaries and affiliated companies	33	29	11	4	16	12	12	8
The American Agricultural Chemical Co.—total	48	40	22	....	14	14	7	13
The American Agricultural Chemical Co., proper	14	13	6	....	8	2	1	5
Subsidiary companies	34	27	16	....	6	12	6	8

TABLE 68.—NUMBER OF BRANDS OF CERTAIN FORMULAS REGISTERED IN STATE OF SOUTH CAROLINA BY SEVEN LARGEST COMPANIES, 1913–14 SEASON—Contd.

Companies.	Formulas.							
	8-3-3	8-4-4	8-2½-1	9-2-2	9-2-3	9-3-3	10-2-2	10-4-4
Armour Fertilizer Works—total	7	7	2	....	7	7	14	5
Armour Fertilizer Works, proper	2	3	1	....	3	3	4	1
Subsidiary companies	5	4	1	....	4	4	10	4
International Agricultural Corporation—total	13	12	7	3	4	2	6	5
International Agricultural Corporation, proper	....	....	....	....	....	....	....	....
Subsidiary and affiliated companies	13	12	7	3	4	2	6	5
F. S. Royster Guano Co.—total	8	11	3	....	3	2	3	5
F. S. Royster Guano Co., proper	3	4	1	....	2	1	1	3
Subsidiary companies	5	7	2	....	1	1	2	2
Swift & Co	7	4	3	1	4	4	3	1
Baugh & Sons Cos	2	....	....	....	....	....	1	....
Total, 7 large companies	159	144	76	59	49	42	49	38
Total other companies	131	106	35	29	61	46	39	31
Total registration	290	250	111	88	110	88	88	69

As the table shows, the Virginia-Carolina Chemical Co. registered no less than 74 brands of a single formula in South Carolina, 41 of which were in its own name and 33 in the name of its subsidiary and affiliated companies. While it is possible to have several mixtures of the same formula without having the constituents derived from the same sources, such a multiplication of brands as this is not due to demands of the trade, but to competitive conditions. It is desirable in preparing fertilizer for different crops to derive the nitrogen from a number of sources and the potash from several different kinds of salts, but for practical purposes the number of combinations for a given formula is limited to perhaps six or eight.

The Vermont Agricultural Experiment Station (Bulletin No. 160, June, 1911) contains the following interesting statements regarding the multiplication of brands and the significance of brand names:

> Brand names may or may not bear relation to the usefulness of the goods. Far too often the words "bone," "guano," "dissolved bone," "high grade," etc., have no significance; frequently the more high flown the name, the lower the grade of the goods; and it often happens that so-called special fertilizers but poorly suit the nature of the crops whose names they bear. Indeed the variations in formulas and guaranties of goods intended for the same crop show that the manufacturers are not a unit in their views as to the crop requirements.
>
> The very firms which strenuously assert the importance of special fertilizers shovel several from the same bin, selling the selfsame goods as corn fertilizers, as potato manures, and as good for all kinds of crops. In fact, as one manufacturer remarks, buyers "prefer to see the word 'potato' on the bags when the goods are purchased for that crop, and 'corn' when bought for the corn crop."

And the local agent is quite apt to charge the buyer a couple of dollars more a ton for the pleasure he derives from seeing the word "potato" instead of the word "corn" on the bags. Instances of this sort are found in each year's inspection. Another case may be cited where a long time standard goods was sold at a much higher price than was the selfsame fertilizer when it bore another and less well-known name, both brands being offered by the same local agent. * * *

Indeed this matter of the multiplication of brands forms one of the anomalies of the fertilizer business as now conducted. There were 161 so-called brands licensed in Vermont in 1911. As a matter of fact there were really only half that number of different kinds of fertilizers sold—84 to be exact—owing to the sale of the same goods under different names. One company sold goods under 63 different names.[1] It really offered, however, but 18 different grades. It sold 6 grades under 48 different names, and 3 grades under 34 names. These variously named goods in each grade were all alike, all apparently made according to the same formula and presumably all, or nearly all, shipped from the same pile. The same thing is true to a less extent of other companies selling in Vermont.

Further commenting on brand names, the same station in Bulletin No. 182, June, 1914, recites as follows:

* * * The names of commercial fertilizers often have no real significance, and there seems little relationship between the name and the composition of the goods. Seventy-five of the 187 licensed brands are named in some general way; 112 may be termed to be specials in that their names indicate their supposed special relationships. The general brands are often "fearfully and wonderfully" bedizened with words. Such titles as "Northwestern Challenge," "New Rival," "Farm Favorite," "Prolific," "Royal," "Banner," "Green Mountain," "Gold Brand," "Extra," "New England," "G," "Oneida," "Empress," "Sterling," "Peerless," "Plymouth Rock," "Farmers' Union," "Never Fail," "Prize Winner," "Imperial," "Atlantic" serve excellently well as a means of identifying the specific brands, which of course is their main function, but they are neither well chosen nor in good taste. It would be easy to ridicule these bombastic titles. They are relics of the day when locomotives and steam engines were named. How much better are the names now beginning to come in, such as "Ten and Eight," "Two, Eight, Ten," which express numerically the plant-food contents of the brands or, if accurately descriptive, such names as "Blood, Bone, and Potash," "Fish and Potash," "Bone, Fish, and Potash," "Tankage and Potash." But there is this much to be said in favor of these grandiloquent names, that they do not mislead. A buyer may learn nothing from them, but at least he does not mislearn. What can one say, however, of the manufacturer who sells a "special potato fertilizer" which has but 1 per cent of potash in it? Yet there is such a brand licensed for sale on Vermont markets. The law does

not and can not control the naming of a brand. It is certainly true, however, that the name cuts less of a figure to-day than formerly; that the Vermont buyer of commercial fertilizers is becoming more careful in his purchases, buying better grades and paying more attention to their plant-food contents.

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[1] The American Agricultural Chemical Co. registered, in 1911, 63 different brands under its own name and 38 additional brands, as follows: Bowker Fertilizer Co., 17; The Coe-Mortimer Co., 8; Lister's Agricultural Chemical Works, 8; and Sanderson Fertilizer and Chemical Co., 5; bringing the total number of brands up to 101 out of a total of 161 for all companies doing business in the State of Vermont. In 1914 The American Agricultural Chemical Co. registered in its own name and through subsidiaries 101 brands, and the Consolidated Rendering Co., through its subsidiary fertilizer companies, 35 brands, making for these two concerns 136 brands, out of a total of 185 brands registered by all companies in the State.

The multiplication of brands and use of brand names leads to frequent conflict as to the rightful owner. Many brand names have a special character which makes it possible to register them under the trade-mark law. The Virginia-Carolina Chemical Co. has about 700 such registered brands. Other brand names consisting of words in general use do not permit of such registration.

The fertilizer manufacturers, as a rule, are in favor of reducing the number of brands. They claim that there are too many formulas and too many brands of the same formula, but they state that competition makes it difficult to cut down the number. They are not so willing to discard brand names and sell according to formula only. They claim that fertilizers can not be sold except under brand names and that some of their brand names are very valuable. They also argue with a good deal of force that if there were no names a dealer would give a farmer any make he chose. The brand names are said to be a protection to illiterate farmers, who in some sections vastly outnumber the educated and up-to-date ones who pay little or no attention to brands but are guided in their purchases by the guaranteed analysis. If a brand of a certain name connected with a picture, say, of a bear or shield, has given good results in one season the illiterate farmer is apt to demand a fertilizer with the same name and picture for the next season. The manufacturers interviewed on the subject of brands admit that brand names mean little or nothing to the better class of farmers, who make a specialty of growing particular crops, such as cotton, tobacco, and peanuts; or are truckers, citrous-fruit growers, etc.

Section 14. Sales, costs, and profits of principal fertilizer manufacturers.

For the purpose of studying the sales, costs, and profits in the fertilizer industry, statements were obtained from several of the largest companies for the fiscal years 1910 to 1914, inclusive. Four companies furnished statements which were sufficiently complete and comparable to admit of use in a combined statement covering the five-year period. This combined statement of sales, costs, and profits from the fertilizer business of these companies, which amounted in 1914 to 3,328,739 tons, valued at $74,186,431.59, is presented in Table 69.

TABLE 69.—COMBINED STATEMENT OF SALES, COSTS, AND PROFITS FROM FERTILIZER BUSINESS OF FOUR LARGE COMPANIES, FISCAL YEARS 1910–1914.

Item.	1910		1911		1912	
	Amount	Average per ton.	Amount.	Average per ton.	Amount.	Average per ton.
Tons sold	2,532,825	....	2,867,942	....	2,805,037	....
Gross sales	$52,003,887.71	$20.53	$60,921,556.37	$21.24	$59,692,278.37	$21.28
Less freights	3,572,077.70	1.41	4,155,543.30	1.45	4,177,581.26	1.49
Less discounts and allowances	2,161,652.54	.85	3,539,768.37	1.23	3,707,368.99	1.32
Net sales	46,270,157.47	18.27	53,226,244.70	18.56	51,807,328.12	18.47
Manufacturing costs:						
Materials[1]	28,260,703.94	11.16	35,105,934.13	12.24	34,599,481.68	12.34
Labor	2,587,087.76	1.02	3,252,153.27	1.13	3,276,439.85	1.17
Supplies and fuel	1,298,597.49	.51	1,560,669.53	.55	1,521,621.61	.54
Insurance	348,418.91	.14	392,920.50	.14	387,761.12	.14
Repairs, renewals, and depreciation	1,346,602.63	.53	1,586,899.70	.55	1,624,611.35	.58
Miscellaneous	589,939.79	.23	777,483.97	.27	910,366.71	.32
Total manufacturing costs	34,431,350.52	13.59	42,676,061.10	14.88	42,320,282.32	15.09
Selling expenses:						
Advertising	274,720.49	.11	357,367.27	.13	414,720.46	.15
Salaries and expenses of salesmen	1,029,967.92	.41	1,209,449.95	.42	1,430,088.64	.51
Commissions	84,019.57	.03	178,123.67	.06	210,367.13	.07
Bad debts	501,652.99	.20	365,364.72	.13	297,251.10	.11
Miscellaneous	909,424.64	.36	1,384,265.45	.48	1,491,521.83	.53
Total selling expense	2,799,785.61	1.11	3,494,571.06	1.22	3,843,949.16	1.37
General and administrative expenses:						
Officers' salaries	364,542.01	.14	438,213.54	.15	496,628.84	.18
Taxes	160,049.20	.06	241,529.45	.09	228,643.96	.08
Miscellaneous	546,935.83	.22	600,603.01	.21	683,058.76	.24
Total general and administrative expense	1,071,527.04	.42	1,280,346.00	.45	1,408,331.56	.50
Total operating expenses	38,302,663.17	15.12	47,450,978.16	16.55	47,572,563.04	16.96
Profit from operation of fertilizer business	7,967,494.30	3.15	5,775,266.54	2.01	4,234,765.08	1.51

[1] See footnote on p. 225.

TABLE 69.—COMBINED STATEMENT OF SALES, COSTS, AND PROFITS FROM FERTILIZER BUSINESS OF FOUR LARGE COMPANIES, FISCAL YEARS 1910–1914—Continued.

Item.	1913		1914	
	Amount.	Average per ton.	Amount.	Average per ton.
Tons sold	2,960,766		3,328,739	
Gross sales	$63,717,849.29	$21.52	$74,186,431.59	$22.29
Less freights	4,504,619.43	1.52	4,907,735.58	1.48
Less discounts and allowances	2,673,320.03	.90	3,626,615.74	1.09
Net sales	56,539,909.83	19.10	65,652,080.27	19.72
Manufacturing costs:				
Materials [1]	37,592,802.31	12.70	44,479,018.18	13.36
Labor	3,446,813.09	1.16	3,691,242.70	1.11
Supplies and fuel	1,954,179.04	.66	2,109,851.52	.64
Insurance	357,819.29	.12	396,350.78	.12
Repairs, renewals, and depreciation	1,244,853.58	.42	1,273,407.98	.38
Miscellaneous	1,031,281.75	.35	1,227,915.99	.37
Total manufacturing costs	45,627,749.06	15.41	53,177,787.15	15.98
Selling expenses:				
Advertising	408,063.23	.14	468,284.04	.14
Salaries and expenses of salesmen	1,487,354.07	.50	1,617,157.98	.49
Commissions	243,932.70	.08	336,095.92	.10
Bad debts	253,477.92	.09	305,125.95	.09
Miscellaneous	1,630,546.29	.55	1,730,448.49	.52
Total selling expense	4,023,374.21	1.36	4,457,112.38	1.34
General and administrative expenses:				
Officers' salaries	504,579.37	.17	531,254.58	.16
Taxes	240,783.31	.08	292,160.21	.09
Miscellaneous	628,527.82	.22	691,065.30	.20
Total general and administrative expense	1,373,890.50	.47	1,514,480.09	.45
Total operating expenses	51,025,013.77	17.24	59,149,379.62	17.77
Profit from operation of fertilizer business	5,514,896.06	1.86	6,502,700.65	1.95

[1] The item of materials contains a considerable amount of intercompany profit, most of which results from the sale of phosphate rock by the mining subsidiaries or departments of these companies to the fertilizer department for use in the manufacture of acid phosphate. The total intercompany profit from phosphate rock for the 5 years and the deduction in the cost per ton of materials necessary to eliminate this item is as follows:

Year.	Intercompany profit.	Deduction per ton.	Year.	Intercompany profit.	Deduction per ton.
1910	$516,688.41	$0.20	1913	$851,822.12	$0.29
1911	678,989.92	.24	1914	644,353.55	.19
1912	761,058.89	.27			

The table shows that the total tonnage of fertilizers sold, the gross sales and net sales increased each year, except in 1912, which was a poor year in the fertilizer industry. The total manufacturing cost also increased each year, except in 1912, when it fell off slightly, while the total selling expense showed a steady increase, and the total general and administrative expense increased each year, except in 1913. The total operating expenses showed a somewhat greater increase than the gross or net sales, so that profits declined. The net increase or decrease in the principal items during the five-year period was as follows:

	Per cent increase.
Tons sold	31
Gross sales	43
Net sales	42
Total manufacturing cost	54
Total selling expense	59
Total general and administrative expense	41
Total operating expenses	54
Profits	[1] *18*

The figures on the ton basis show that the average price per ton of fertilizers sold increased each year, the total increase in average price during the five-year period amounting to $1.76 per ton, or 9 per cent. Freights per ton increased from $1.41 in 1910 to $1.52 in 1913 and then declined to $1.48 in 1914. Discounts and allowances per ton increased from 85 cents in 1910 to $1.32 in 1912 and then decreased to 90 cents in 1913. In 1914 they increased again to $1.09. Net sales per ton increased from $18.27 in 1910 to $18.56 in 1911 and then fell off to $18.47 in 1912. In 1913 they increased again to $19.10 and in 1914 to $19.72, making a net increase for the period of 8 per cent.

The total manufacturing costs per ton increased continuously from $13.59 in 1910 to $15.98 in 1914, or 18 per cent. The cost of materials per ton also rose steadily during this period, increasing from $11.16 in 1910 to $13.36 in 1914, or 20 per cent, so that of the total increase in manufacturing cost of $2.39 per ton, $2.20 was due to the increase in the cost of materials alone. This increase in the cost of materials was largely in the nitrates and ammoniates used, for the prices of potash salts remained stable from May, 1911, with the exception of the 3 per cent advance which became effective on January 1, 1914, too late to affect to any appreciable extent the cost of the materials used for that fiscal year, and the cost of the acid phosphate used declined rather than advanced during this period, especially for quantities purchased in the open market.

The labor cost per ton rose from $1.02 in 1910 to $1.17 in 1912 and then declined to $1.16 in 1913 and $1.11 in 1914, making the net increase for the period 9 per cent. The other items of manufacturing cost, except insurance, show an increase per ton from 1910 to 1912, inclusive, though in some instances they show a decrease since 1912.

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[1] Decrease.

The total selling expense per ton increased from $1.11 in 1910 to $1.34 in 1914, or 20 per cent. This cost per ton was highest in 1912, when it reached $1.37. Most of the separate items of selling expense show some increase during the period, but the item of bad debts declined, owing, in part at least, to the establishment by the large companies of better credit organizations. The expenses of the credit departments, however, increased. These expenses are included in the miscellaneous item of selling expense, which increased from 36 cents per ton in 1910 to 55 cents in 1913 and 52 cents in 1914, a 44 per cent increase for the five-year period. Taking the two items of bad debts and miscellaneous expenses together, the maximum increase has been only 8 cents per ton—from 56 cents in 1910 to 64 cents in 1912 and 1913. The 1914 figure was 61 cents, making a net increase of 5 cents per ton for the five-year period, or about 9 per cent.

The total general and administrative expense per ton increased from 42 cents in 1910 to 50 cents in 1912, and then decreased to 45 cents in 1914.

The total operating expenses per ton increased from $15.12 in 1910 to $17.77 in 1914, or 18 per cent, while profits per ton declined from $3.15 in 1910 to $1.51 in 1912 and then rose to $1.86 in 1913 and $1.95 in 1914, the net decrease being 38 per cent.

In Table 70 are presented the percentages of the same items of cost as are shown in the preceding table, figured on net sales.

TABLE 70.—COMBINED STATEMENT OF PER CENT OF COSTS AND PROFITS TO NET SALES OF FOUR LARGE COMPANIES, FISCAL YEARS 1910–1914.

Item.	1910	1911	1912	1913	1914
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Net sales	100.00	100.00	100.00	100.00	100.00
Manufacturing costs:					
Materials	61.1	66.0	66.8	66.5	67.8
Labor	5.6	6.1	6.3	6.1	5.6
Supplies and fuel	2.8	2.9	2.9	3.5	3.2
Insurance	.7	.7	.8	.6	.6
Repairs, renewals, and depreciation	2.9	3.0	3.1	2.2	1.9
Miscellaneous	1.3	1.5	1.8	1.8	1.9
Total manufacturing costs	74.4	80.2	81.7	80.7	81.0
Selling expenses:					
Advertising	.6	.6	.8	.7	.7
Salaries and expenses of salesmen	2.2	2.3	2.7	2.6	2.5
Commissions	.2	.3	.4	.4	.5
Bad debts	1.1	.7	.6	.5	.5
Miscellaneous	2.0	2.6	2.9	2.9	2.6
Total selling expense	6.1	6.5	7.4	7.1	6.8
General and administrative expense:					
Officers' salaries	.8	.8	1.0	.9	.8
Taxes	.3	.5	.4	.4	.4
Miscellaneous	1.2	1.1	1.3	1.1	1.1
Total general and administrative expense	2.3	2.4	2.7	2.4	2.3
Total operating expenses	82.8	89.1	91.8	90.2	90.1
Profit from operation of fertilizer business	17.2	10.9	8.2	9.8	9.9

As shown by the table, the total manufacturing cost amounted in 1914 to 81 per cent of net sales, the total selling expense to 6.8 per cent, and total general and administrative expense to 2.3 per cent, making the total operating expenses equal to 90.1 per cent of net sales and profits 9.9 per cent.

The cost of materials used is the largest item of cost, forming 67.8 per cent of the net sales in 1914. Labor and supplies and fuel are next in importance, amounting together to 8.8 per cent of net sales in 1914. Of the selling expenses the salaries and expenses of salesmen are the most important single item, amounting in 1914 to 2.5 per cent of net sales.

Profit on investment.—The mixed fertilizer business requires large capital, since the turnover for the larger companies averages less than once a year. Some of the materials are purchased in the summer and fall, mixed together during the winter, and distributed to the trade in the early spring. Most of the final settlements are not made until the following November and December, and some of the notes taken as payment have to be carried for a still longer time.

In Table 71 below is shown the total net book investment, exclusive of good will, obtained by taking the book value of the lands, buildings, and equipment, other investments in the fertilizer business, and the net working capital (current assets less current liabilities) of four large companies by years for the period of 1910–1914. The net operating profit is also shown and the per cent of same on the said net investment. The investment in phosphate-rock properties, railroads, and cotton-oil companies has been excluded in order to make the investment figures comparable with the operating profit figures, which are the returns on the fertilizer business only. Investment in brands, good will, trade-marks, etc., has also been excluded.

TABLE 71.—NET BOOK INVESTMENT (EXCLUSIVE OF GOOD WILL), OPERATING PROFIT, AND PER CENT OF PROFIT ON SUCH INVESTMENT OF FOUR LARGE COMPANIES, BY FISCAL YEARS, 1910–1914.

Year.	Lands, buildings, and equipment.	Sundry investments.	Net working capital.	Total net investment.	Net operating profit.	Per cent of profit on net investment.
1910	$36,304,868.07	$891,581.91	$46,986,629.36	$84,183,079.34	$7,967,494.30	9.5
1911	38,107,063.00	1,836,172.14	49,128,645.70	89,071,880.84	5,775,266.54	6.5
1912	40,091,784.82	736,630.31	58,933,817.01	99,762,232.14	4,234,765.08	4.2
1913	41,809,942.79	769,388.04	55,921,384.69	98,500,715.52	5,514,896.06	5.6
1914	43,226,459.43	692,854.91	63,498,534.81	107,417,849.15	6,502,700.65	6.1

The increase in this net book investment for the five-year period was $23,234,769.81, or more than 27 per cent; at the same time the net operating profit was $1,464,793.65 less in 1914 than in 1910, a decrease of more than 18 per cent. The per cent of profit on this net book investment was 9.5 in 1910, 6.5 in 1911, and only 4.2 in

1912, since which date it has increased to 5.6 in 1913 and 6.1 in 1914. The average return on this investment for the five-year period was 6.4 per cent for the four companies combined, 5.8 per cent for the two larger, and 10.5 for the two smaller companies. In 1910 for individual companies the profit ranged from 7.4 to 17.8 per cent, in 1912 from less than 0.3 to 9.2 per cent, and in 1914 from 3.8 to 11.8 per cent. One company shows a steady decrease in return on this net book investment except for the year 1913, which was slightly higher than 1912 and about 1 per cent higher than 1914. The year 1912 was the poorest one for two of the four companies, 1913 being the poorest for the third and 1914 for the fourth. Returns from two of these companies indicate that the profits for the fiscal year 1915 were larger than for the preceding year in spite of a somewhat reduced output.

A comparison of the rates of profit on sales with rates on net book investment, exclusive of good will, by companies for the five-year period is shown in Table 72 below. The table also shows the averages for the five-year period and the combined averages by years.

TABLE 72.—RATES OF PROFIT ON NET SALES AND NET BOOK INVESTMENT, EXCLUSIVE OF GOOD WILL, BY COMPANIES AND COMBINED, BY FISCAL YEARS, 1910–1914.

Company.	1910		1911		1912		1913		1914		5-year period.	
	Net sales.	Net investment.	Net sales.	Net investment.	Net sales.	Net investment.	Net sales.	Net investment.	Net sales.	Net investment.	Net sales.	Net investment.
	P. ct.	*P. ct.*	*t.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
A	19.1	7.4	6.1	2.8	4.5	1.5	8.0	3.1	9.1	3.8	9.4	3.7
B	15.9	10.3	14.3	8.3	11.7	6.7	12.2	7.3	10.5	6.2	12.7	7.6
C	21.3	17.8	10.7	10.1	.3	.3	6.7	6.8	9.1	8.8	9.3	8.6
D	13.7	14.9	13.9	16.6	9.0	9.2	8.9	8.9	10.1	11.8	10.8	11.7
Combined	17.2	9.5	10.9	6.5	8.2	4.2	9.8	5.6	9.9	6.1	11.0	6.3

The average rate of profit for all companies for the whole period was 11 per cent on net sales and 6.3 per cent on net book investment exclusive of good will.

In discussing the profits upon net investment of the four fertilizer companies it should be noted that the present book value is used and not the actual cost of investment. Two of the companies included in this statement were combinations of various competing concerns in which the properties acquired were usually paid for, in part at least, by the issue of stock. Experience shows that where such mergers are made there is a strong tendency to overcapitalization, and consequently to an exaggeration of the value of the properties acquired as recorded on the books of the consolidation. Indeed, one of the companies included has admitted that the original book value of certain properties was in excess of the actual value at the time of acquisition. Furthermore, another of the companies included in the foregoing statement recently had an appraisal made of its manufacturing properties which showed an appreciation of about $3,000,000 over the original book value, and in consequence of this appraisal it increased its book investment by the said amount. It should be noted, on the other hand, that good will values have not been included in the foregoing statement of investment, and it is possible that these represented in some cases a considerable cash outlay. The foregoing statement of profit on investment, therefore, relates simply to profit on the present book value of the tangible investment, which does not include any investment in good will. It would be desirable, if practicable, to determine the rate of profit on the actual cost of investment, which is the only satisfactory basis in a case like this. To determine, however, the actual cost of investment of some of these companies would require an exhaustive investigation into their organization and financial operations, which has not been deemed necessary for this report, which deals primarily with the production, sale, and prices of fertilizer materials.

Section 15. Comparison of mixed fertilizer prices with prices of materials.

The return on the net book investment obtained by the large fertilizer manufacturers, in so far as it is a criterion of the real return, indicates that the prices charged for mixed goods, which constitute about 80 per cent of their total fertilizer business, have not been unreasonably high from the manufacturers' standpoint. Viewed, however, from the standpoint of what the materials cost the farmer in mixed form, as compared with what they cost him unmixed if purchased for cash, the opposite conclusion would be reached. The cost of materials to the large fertilizer manufacturer represents only about 75 per cent of the total operating cost, on account of the various overhead and selling expenses incident to large scale and credit operations, while for the farmer who mixes his own fertilizer the cost of materials constitutes the total cost of the finished product, except for a small labor cost of mixing. Further, in recent years, as shown in Chapter VII, page 161, a farmer who could pay cash and buy in large quantities has been able to obtain his materials at prices but little above those paid by the large fertilizer manufacturer, so that even if the latter were selling at cost the farmer would be able to realize considerable saving by home mixing.

The Federal Trade Commission has collected considerable information regarding the prices paid by farmers for mixed fertilizers and what their fertilizers would have cost them if they had bought the materials for cash and mixed them at home. For the States of

Georgia and South Carolina data are presented showing the cost of materials in various formulas delivered to farmers and the prices which they actually paid. The cost of materials in certain formulas shown below for cash purchases in Georgia and South Carolina was computed by using a range of the average monthly cash prices (January to June, 1914) f. o. b. Savannah and Charleston of nitrate of soda, muriate of potash, and 16 per cent acid phosphate shown in Chapter VII, page 161, plus a freight charge ranging from $0.72 to $3.15 per ton. The maximum freight rate is sufficient to reach all points in the State of Georgia, except the section north of a line running through Atlanta and Athens and all of South Carolina except the extreme western tier of counties.

In computing the value of the formulas the nitrogen expressed as ammonia is derived one-half from nitrate of soda and one-half from cottonseed meal, it being impossible to ascertain exactly the sources of nitrogen in a given formula of mixed fertilizer. This method is fair, since, as shown in Chapter VI, page 156, cottonseed meal, on the basis of its nitrogen content, is usually the most expensive of the organic ammoniates, and nitrate of soda and sulphate of ammonia, which are the inorganic ammoniates most used as a source of nitrogen in mixed goods, usually cost about the same per unit of nitrogen. This was especially the case in the Spring of 1914. The cash price of cottonseed meal used was $26 low and $30 high, delivered to the farmer. The fairness of these figures is shown by the fact that the average monthly wholesale price f. o. b. Georgia mills for not less than 10 ton lots ranged from $25.61 to $26.89 during the first half of 1914, while in less than 10-ton lots the average monthly prices ranged from $26.16 to $28.17 per ton.

Table 73 following shows the cost of a unit of ammonia, phosphoric acid and potash obtained by dividing the total cost of materials at destination by the number of units of these compounds contained in the materials.

TABLE 73.—ESTIMATED COST OF MATERIALS, PER TON AND PER UNIT, AT INTERIOR DELIVERY POINTS IN GEORGIA AND SOUTH CAROLINA, 1914.

Item.	Nitrate of soda (18 per cent).	Muriate of potash (48 per cent).	Acid phosphate (16 per cent).	Cottonseed-meal (7½ per cent).
Range of average monthly cash prices per net ton f. o. b. Charleston, S. C., or Savannah, Ga.	$42.82–$47.41	$36.00–$37.53	$7.91– $9.01	[1] $26.00–$30.00
Range of freight rates to interior delivery points	.72– 3.15	.72– 3.15	.72– 3.15	....
Total cost per ton at destination	43.54– 50.56	36.72– 40.68	8.63– 12.16	26.00– 30.00
Average cost per unit at delivery point.	[2] 2.42– 2.81	[3] .77– .85	[4] .54– .76	[2] 3.47– 4.00

[1] Estimated delivered price.
[2] Ammonia; no allowance made for potash and phosphoric acid content in the cottonseed meal.
[3] Potash.
[4] Phosphoric acid.

The cost of materials in any formula of complete fertilizer can be computed by multiplying the unit costs given above by the number of units in the formula. Thus, in an 8-2-2 fertilizer the cost of the 8 units of phosphoric acid would be 8×54 cents low and 8×76 cents high. The cost of the 2 units of potash would be 2×77 cents low and 2×85 cents high. The cost of the 2 units of ammonia derived one-half from nitrate of soda and one-half from cottonseed meal would be 1×\$2.42+1×\$3.47 low and 1×\$2.81+1×\$4 high. The following table shows the cost of materials for various formulas of complete fertilizers computed in this manner:[1]

TABLE 74.—ESTIMATED COST OF MATERIALS, IN FIVE IMPORTANT FORMULAS, TO FARMERS IN GEORGIA AND SOUTH CAROLINA, 1914.

Formula.	Ammonia.		Phosphoric acid.	Potash.	Total cost.
	Nitrate of soda.	Cottonseed meal.	16 per cent acid phosphate.	Muriate of potash.	
8-2-2	\$2.42-2.81	\$3.47-4.00	\$4.32-6.08	\$1.54-1.70	\$11.75-14.59
8-3-3	3.63-4.22	5.21-6.00	4.32-6.08	2.31-2.55	15.47-18.85
9-2-3	2.42-2.81	3.47-4.00	4.86-6.84	2.31-2.55	13.06-16.20
9.2-2-2	2.42-2.81	3.47-4.00	4.97-6.99	1.54-1.70	12.40-15.50
8-4-4	4.84-5.62	6.94-8.00	4.32-6.08	3.08-3.40	19.18-23.10

The above figures show what farmers in the States of Georgia and South Carolina could have purchased their fertilizers for in unmixed form. Below are presented some prices actually paid by the better class of farmers for the same formulas in mixed form. Information indicates that small farmers and tenant farmers paid prices considerably in excess of those given.

The lowest price noted for an 8-2-2 formula in the States of Georgia and South Carolina during the 1914 season was \$18.50 per ton for a cash purchase, as compared with the computed cash value of materials shown above of \$11.75 low and \$14.59 high. Credit prices paid by 13 farmers for this formula ranged from \$19.50 low at Jefferson, Ga., to \$23 high at Athens, thus showing a difference of \$3.50 per ton in the same section of the State. Two of the 13 farmers paid \$21, two \$21.50, four \$22, and two \$22.50. The spring list time price in 1914 of the Virginia-Carolina Chemical Co. and other fertilizer manufacturers to merchants for resale in these States was \$21 f. o. b. interior factory points and \$21.50 delivered to all other points, with 5 per cent off for cash May 1 and usually 5 per cent additional as a trade discount.

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[1] The weight of these home-mixed formulas would be considerably less than 2,000 pounds since only high-grade materials are used, and no account is taken of filler which is added to mixed goods made of high-grade materials. It is not necessary for the farmer to add such filler, nor would it materially increase the cost of it if it were added, since ordinary sand or earth would answer the purpose.

The lowest price noted in the States of Georgia and South Carolina for an 8–3–3 formula was $20.55 per ton for a cash purchase, as compared with a cash value for materials of $15.47 low and $18.85 high. The time prices reported ranged from $24.25 low to $26.50 high. Twelve farmers paid from $24.70 to $25.50. The list time price of the Virginia-Carolina Chemical Co. and other fertilizer manufacturers to merchants for resale for this formula was $25.50 f. o. b. interior factory points and $26.00 delivered at all other interior points, with the regular cash and trade discounts.

No cash prices were reported for a 9–2–3 fertilizer. Credit prices ranged from $21.45 to $23.50 per ton. Of 20 farmers at Lexington, Ga., buying this formula on credit, two paid $21.95, two $22.50, three $23, six $23.10, and seven $23.50. The Virginia-Carolina Chemical Co.'s list price to merchants at Lexington for resale was $23.10 delivered, with the usual cash and trade discounts. The computed cash value of this formula, including freight, for the State of Georgia and South Carolina, shown in Table 74 above, was $13.06 low and $16.20 high.

Thirty-one farmers buying 9.2–2–2 fertilizer on credit at Anderson, Greenville, and Spartanburg, S. C., paid from $20 to $22 per ton. Seven paid $20.40, nine paid $21, six $21.50, and six $22 per ton. These three towns are factory points; the list price to merchants for resale was $21.50 per ton. In comparison the computed cash value of the materials in this formula, including freight, as shown in Table 74, ranged from $12.40 low to $15.50 high.

The lowest price noted for 8–4–4 was $24.30 at Sumter, S. C., for a cash purchase. The estimated cost, including freight, at this point, which takes a freight rate of $1.65 per ton from Charleston, would be slightly more than $20 per ton. Credit prices ranged from $28 per ton to $30.50. The list price of this formula to merchants was $30 at interior factory points and $30.50 at interior delivery points. The computed cost of the materials, including freight, for the States of Georgia and South Carolina was $19.18 low and $23.10 high.

In the spring of 1915 the prices of mixed fertilizers were increased nearly $1 a ton on account of the increased cost of potash and some of the other materials. The scarcity of potash and the extremely high resale price resulting from the embargo placed on exportation by the German Government in January, 1915, made it difficult if not impossible for farmers and small dry mixers to compete with the mixed fertilizer manufacturers who had large stocks on hand, so that most of the increase in price was collected. The potash in the mixed fertilizers was cheaper than in the unmixed form.

Economy of home mixing.—The wide margin between the cost of mixed fertilizers and the cost of mixing the same formulas at home when the materials can be purchased for cash is doubtless the principal reason for the active propaganda in favor of home mixing and the extent to which this practice has spread in certain localities.[1] Nearly every agricultural experiment station in the United States, as well as the United States Department of Agriculture, advocates the purchase and home mixing of fertilizer materials, the main reasons given being that it means a saving of several dollars per ton, as compared with the cost of factory-mixed goods, that the farmer knows the sources of plant food, and that he can adapt the mixtures to the needs of the soil and crops. The first-named reason appears to be regarded as the most important.

Information obtained from farmers and Agricultural Experiment stations indicates that the labor cost of mixing at home ranges from 25 cents to $1 per ton, depending upon the condition of the nitrate of soda and other factors, and also that the possible saving above computed for Georgia and South Carolina farmers is representative of what farmers can save generally if they have the cash with which to purchase their materials cheaply.

One person interviewed on the question of home mixing who is the manager and organizer of a large farmers' club and who has been doing his own mixing for the last eight years, states that the cost of mixing does not exceed 25 cents per ton, and that three men in half a day can properly mix and bag 10 tons of fertilizer. Another informant who keeps cost accounts of fertilizers, says that three men will mix and rebag 7 tons in three-fourths of a day, the cost being $2.25 or 30 cents per ton. He estimates the saving per ton on fertilizer containing 2.2 per cent ammonia, 11½ per cent phosphoric acid, and 7½ per cent potash in 1913 to have been $5.30. The total cost of this fertilizer was $22.40 per ton. The mixing was done at a time when the labor could not be used for other purposes. The materials used were nitrate of soda, dried blood, tankage, dried fish scrap, muriate of potash and 16 per cent acid phosphate.

A prominent farmer in western Maryland says (1914):

> Five of my men will empty, mix, sift or screen, and resack 20 tons per day and do the feeding and watering of 16 horses. Price per day, $1 and board—about $7, while working on the fertilizer or 35 cents per ton.

One farming concern in central New York which has purchased from 90 to 100 tons of fertilizer materials annually and mixed them for its own use for more than 10 years estimates the cost of mixing at $2 per ton, due to the high wages paid to labor. Even at this cost of mixing the saving per ton on fertilizer as sold by manufacturers is estimated to be $6. Another concern in the same locality has practiced home mixing for several years and used in 1913 about 500 tons of materials. The cost of mixing is estimated at 75 cents per ton.

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[1] In some of the Southern States home mixing has been practiced extensively in certain localities, particularly in trucking sections. An informant in Scotland County, N. C., says that in 1914 about 60 per cent of all the fertilizers used in that territory were home mixed. An authority in Sumter County, S. C., states that in 1914 home mixing was on the increase and that at least 60 per cent of the sales were materials for home mixing.

A prominent farmer in the same vicinity who has home mixed for several years, states that the cost of mixing and bagging ranges from 75 cents to $1 per ton, depending on the condition of the nitrate of soda. If it is hard and lumpy and has to be broken up with hammers, the çost is $1; if in good condition, 75 cents per ton.

Regarding the economy of home mixing, a prominent fertilizer official in one of the Southern States makes the following statement (1914):

> The extent of home mixing in most localities has grown by leaps and bounds within the last three or four years. The factors favoring this growth are better information of the farmer as to the economy involved in home mixing, and, second, the ability to know the character of the materials which enter into the composition of his fertilizer. From the most reliable information obtainable, the farmer can save from $5 to $8 per ton by doing his own mixing. Intelligent farmers have told us with the crude implements found on most farms they can mix at a cost of 50 cents to $1 per ton, and estimate an average saving of about $6 below the cost of the mixed product when bought, even allowing the manufacturer interest on money invested in his machinery, cost of bagging and tagging in most cases being about the same, except perhaps the farmer can hire his labor rather cheaper than the manufacturer is forced to pay.

The 1914 report of the Vermont Agricultural Experiment Station (p. 296) contains the following illustration of the saving effected by home mixing:

> * * * This spring the station bought 1,300 pounds of nitrate of soda, 2,700 pounds of tankage, 10,600 pounds of acid phosphate, and 3,700 pounds of muriate of potash. The delivered cost was $209.79. The average complete fertilizer sold on time, delivered in small lots, sold this year at $32.53 per ton, and contained about 2.3 per cent nitrogen, 7.9 per cent available phosphoric acid, and 5.8 per cent potash. Let us make a comparison of the relative amounts of plant food bought for the same sum, i. e., $32.53:

Delivered.	Nitrogen.	Available phosphoric acid.	Potash.
	Pounds.	*Pounds.*	*Pounds.*
In mixed goods on time	46	158	116
In crude stock delivered for cash	55	295	287

> Any farmer who appreciates that 295 is larger than 158, who realizes that 287 is in excess of 116, and can see that 55 is a somewhat greater figure than is 46 ought to realize which is the better purchase. The only extra investment the station had to make was the mixing of the goods, which doubtless cost somewhere between 50 cents and a dollar a ton. * * *

A fairer comparison than the one above would be obtained by using the cost of mixed goods sold for cash. It is apparent, however, that even with a liberal discount for cash the number of pounds of nitrogen, phosphoric acid, and potash purchased in the form of mixed fertilizer was considerably less than the number of pounds of the same elements that could be purchased with the same money in the form of materials.

The Vermont Agricultural Experiment Station bulletins (Nos. 160, 173, and 182) give the average retail selling price of commercial fertilizers as compared with the retail cash prices of materials in the principal seacoast markets. For instance, in 1911 the average selling price and value were $31.41 and $19.53, respectively; in 1912, $32.03 and $20.09; in 1913, $32.64 and $21.24; and in 1914, $32.53 and $20.35, differences of $11.88, $11.94, $11.40, and $12.18, respectively. These figures, it is contended, support the conclusion that one dollar in three spent for mixed fertilizers is paid to the manufacturers, railroad, and selling agent for their work, while but two of the three are paid for plant food.

Obstacles to home mixing.—With the savings possible from home mixing the question naturally arises why home mixing is not more generally practiced. In addition to the labor cost of mixing at home, there are other factors which a farmer may take into consideration in deciding whether to do his own mixing. It is undoubtedly more convenient for a farmer who has a large acreage and wants his fertilizers quickly to purchase his fertilizers in mixed form. In order to realize the saving indicated above he must forego this convenience. Furthermore, the farmer may not always have proper storage facilities for keeping his materials until he is ready to use them. The fertilizer manufacturers also claim that as the result of the expensive machinery employed the factory-mixed fertilizers are more thoroughly mixed than those mixed with a shovel and screen. There would appear to be some foundation for this claim, although none of the numerous farmers interviewed on this subject reported that their fertilizers mixed by hand produced "spotted" or "streaked" crops. The main reasons given by farmers in the large consuming States in the South for purchasing mixed fertilizers rather than fertilizer materials are "lack of cash," "lack of knowledge," "credit system," and "lack of cooperation." A very few mentioned "labor cost" and inability to buy materials from local dealers. The most important of these reasons undoubtedly is the lack of cash. There is little or no saving in home mixing unless a farmer can purchase his materials in carload quantities and pay cash for them. The credit prices of materials are as high correspondingly as the credit prices of mixed goods (see p. 162), the fertilizer manufacturers and local dealers being the only concerns selling on this basis, and interest rates on agricultural credits in the South are so high that there is, as a rule, no economy in borrowing money with which to purchase fertilizers for cash.

Lack of cooperation is also an important cause, where a farmer consumes less than a carload of materials, for it is necessary for him then to join with other farmers in order to purchase in large enough quantities to realize the economies of home mixing. This cooperation has been successfully carried on in many sections of the South through the agency of farmers' clubs and farmers' unions. The agents of the Office of Extension Work in the South of the States Relations Service of the Department of Agriculture (formerly Farmers' Cooperative Demonstration Work), have done much to encourage the formation of these clubs and to bring about cooperative buying by farmers.

Owing to the importance of the credit conditions in the South as a factor in the high retail prices of fertilizers a brief description of the present rural credit system follows:

Rural credit system.—In the South the conditions affecting both farm mortgage and short-time loans have been described as being exceptionally bad. The farmers there are of three classes. The first class comprises the landlords who own large tracts of land which are worked by tenants, and have commissaries or supply houses on their plantations, and who are often interested in the local banks and supply houses. The second class are the small farmers who till the land which they own or at least have an equity in. The third and largest class are the tenants. More than 60 per cent of the farms in the State of South Carolina, and nearly two-thirds of those in Georgia, Alabama, and Mississippi, are operated by tenants. Of more than 46,000 farms in 8 counties in the Yazoo Valley in Mississippi in 1910, 90 per cent were operated by tenants. These small farmers and tenants are the ones who are unable to obtain financial accommodations except upon very burdensome terms.

There are several sources from which the farmer secures accommodations, the two principal ones being the local bank and the local advancing or supply merchant. The average small farmer must rely mainly upon the latter source. A common practice of banks, particularly in the South, is to charge very high interest on personal credit extended to farmers. While all the States have usury laws which limit the rate of interest that may be charged, they are frequently violated and often evaded by both banks and merchants. Interest rates vary according to the credit standing of the borrower and the amount of the loan, small loans usually taking the highest rate. The well-to-do farmers are usually depositors and often stockholders in the local bank and, therefore, receive favorable terms, while the small farmers and tenants who are not regular depositors must pay high rates if they can get credit at all. In borrowing money from banks or in purchasing supplies from merchants the small farmers and the tenants are sometimes required to sign waiver notes in which crops, mules, wagons, implements, etc., are named as collateral security. The rate of interest on short-term loans varies from 8 to 10 per cent to as much as 200 per cent a year, while the rate of discount ranges from 8 per cent to as much as 50 per cent. In order to avoid the usury laws the rate of interest does not usually appear on the face of the note; thus the farmer wishing to borrow $100 for 3 months would receive only $90 in case the rate of discount was 10 per cent. On this basis his annual rate of interest would amount to more than 44 per cent. The requirements of the small farmer are generally for a much longer time than 3 months, the usual period being 8 or 9 months. To obtain such loans the farmer goes to the bank in February or March and makes out a note for such an amount as may be agreed upon and estimated to be sufficient to meet his needs during the crop season. The note is discounted by the bank at 8 per cent if the farmer is a depositor or regular customer, and at 10 per cent or more if otherwise. The note is made payable October 1 or November 1. The farmer is not usually allowed to withdraw the whole amount of the loan at one time, but in installments to meet current expenses. In this way the bank has the use of some of the money, on which the farmer has paid interest, for the greater part of the time the note is to run. The average time that the whole amount is out of the bank is not more than 4 or 5 months, making the rate of interest paid by the farmer receiving the minimum discount of 8 per cent range from 21 to 26 per cent per annum.

The following statement is taken from the report to the Governor of North Carolina on the needs of farmers with regard to credits, marketing, and cooperation:[1]

> At the present time the manufacturers, the merchants, and business men in the cities of North Carolina have a practical monopoly of short-time credit. The average farmer either has no credit at all or is compelled to use such forms of high-priced credit as he can obtain from the merchant. * * * It is estimated that there are at least 200,000 persons engaged in agriculture in North Carolina that have not sufficient stored-up property to give them standing * * * at the present commercial banks, but these people greatly need money at reasonable rates of interest for purchasing supplies, fertilizers, seed, and for paying for labor.

Attention has also been directed by the Federal Reserve Board and the Comptroller of the Currency[2] to the very high interest rates

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[1] Joint hearings before the subcommittees of the Committees on Banking and Currency, Rural Credits, 63d Cong., 2d sess., p. 489.

[2] In a speech before the Chamber of Commerce at Raleigh, N. C., Sept. 20, 1915, W. P. G. Harding, of the Federal Reserve Board, said:

"The Comptroller of the Currency has information from sworn reports to his office regarding the maximum and average interest rates charged by national banks throughout the United States. From the report of June 23, 1915, it appears that there are five national banks in Alabama whose maximum rates of interest average 26 per cent, the rate in one case being 60 per cent and in another 34 per cent. The average rate of interest which one of these banks was charging on all of its loans amounted to 12 per cent, another 10 per cent. In Arkansas one national bank admitted making a loan at a rate as high as 120 per cent, another one at 50 per cent, another at 60, and another at 25. In Georgia there were 11 banks where the average maximum rate of interest was about charged by national banks throughout the United States and particularly in the South.

The small farmer desiring to do business with the advancing merchant usually gives him a note in February or March sufficient to cover his needs during the crop season, which ends in September or October. This note is discounted by the merchant at a rate varying from 8 to 20 per cent, so that the borrower receives credit for from $80 to $92 on each $100 borrowed. The notes are often secured by a crop or chattel mortgage covering the mortgagor's growing crops, stock, implements, furniture, etc., which may be sold in case of failure of the crop or failure of the farmer to meet the requirements of the merchant in regard to working the crop or paying the note at maturity. The merchant furnishes fertilizers, implements, provisions, etc., from time to time up to the face value of the note less discount. At the beginning of the season the farmer is allowed as little as possible on his note, but as the season advances the merchant becomes more liberal, especially if the crop prospects are good. The credit extended by the merchant is based on the number of acres of cotton planted or the number of bales the farmer expects to raise. The notes taken by the merchant are often used as collateral security for loans extended to him by the local bank. In addition to the discount on the note the merchant also makes a profit on the merchandise and other supplies advanced to the farmer. The profits on the groceries and dry goods which the farmer must have during the season are usually larger than on the fertilizers advanced. The very high prices of fertilizers above referred to, however, are the credit prices of these advancing merchants.

The present credit conditions undoubtedly work to the advantage of the fertilizer manufacturers who are able to furnish credit to their customers. The great majority of farmers do not have the cash with which to purchase fertilizers, so that they must either borrow money or buy on time. Only a few are able to borrow on favorable terms. Under such conditions it is cheaper to buy mixed fertilizers on time than to borrow money in order to purchase them for cash.

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30 per cent. The maximum rate charged by one of these banks was 40 per cent and the average on all loans was 15 per cent. No bank in South Carolina admitted charging more than 15 per cent. In Texas a number of banks reported rates in excess of 100 per cent, and many of them stated that their average rates on all loans were 1 per cent per month or more. These high rates, however, are not confined exclusively to the South, for the reports show occasional rates of 50 per cent in the East and North as well as in the far West and South."

On Oct. 6, 1915, at Frankfort, Ky., in an address before the Kentucky Bankers' Association, John Skelton Williams, Comptroller of the Currency, said in regard to excessive interest charges by national banks in part as follows:

"The reports received at the Comptroller's office show indisputably that in some States and sections borrowers, especially small borrowers, have been and are being subjected to extortions and exactions which the average man would consider impossible in this enlightened age. * * * The saddest part of it is that these exactions are wrung from the poorest men in the community, especially the small farmers, who can least afford to pay the fearful tribute extorted from their necessity."

To meet the needs of the small farmer, particularly the tenant or the landowner whose farm is already mortgaged, is a serious problem. No rural credit scheme yet proposed is adapted to such conditions. The owner of unencumbered land can usually obtain the money he needs if he meets interest payments promptly. The tenant and the landowner already in debt have no security to offer except chattels and growing crops, and such security is often not sure enough to command favorable terms on loans.

Section 16. Former agreements in restraint of trade.

The use of the list prices of the Virginia-Carolina Chemical Co. by practically every other fertilizer concern doing business in the Southern States has given rise to the belief that the fertilizer manufacturers were parties to a secret agreement to control prices in this territory. Investigation shows, however, that, while the list prices and certain discounts for cash have been fairly uniform throughout both the Northern and Southern States, no uniformity has existed in recent years in the actual prices charged because of the allowances and concessions which have been granted to secure business. To really control prices it would be necessary for fertilizer manufacturers to agree among themselves not to grant concessions and allowances or to make them uniform, and also to establish and enforce heavy penalties for any rebating by parties to the agreement. Such an agreement in restraint of trade was successfully organized and carried out by the fertilizer companies during the fiscal years 1904 and 1905 through the agency of a dummy corporation known as the Colonial Development Co. (Ltd.).

Colonial Development Co.—In the summer of 1903 representatives of a number of fertilizer manufacturers doing business in the Southern States formulated a plan for maintaining the prices of mixed fertilizer and fertilizer materials in the States of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Tennessee. This plan was presented to the representatives of the principal fertilizer companies on August 24, 1903, and finally approved on September 16, 1903.

In accordance with this plan, the Colonial Development Co. (Ltd.) was organized under the laws of the Province of Ontario, receiving its charter on August 19, 1903. The purpose of the company, as stated in its charter, was—

> (*a*) To develop and improve lands, and the use and productiveness thereof, for agricultural, horticultural, and grazing purposes; to supply seeds to manufacturers and otherwise produce, purchase, and otherwise acquire, sell, supply, and deal in implements, appliances, fertilizer, and other articles and things required, used, or necessary for the proper and successful cultivation of the soil; to provide arrangements and facilities for the purchase, sale, transportation, and storage of the products of the soil and of any of the articles and things

above mentioned; and (*b*) to enter into any arrangements for sharing profits or union of interests, reciprocal concession, or joint adventure with any person, firm, or corporation carrying on any like or similar business to any of those authorized hereunder, and to aid, by way of indorsement, guaranty, advances, assurances, bonus, or otherwise, any such person, firm, or corporation.

The real purpose of the corporation, however, according to the statement of the person who formulated the price-fixing arrangement, was as follows:

> First. To arrange the prices and terms of settlement for the fertilizers (complete and alkaline goods, and acid phosphate) sold and used to grow crops in the States of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana (east of the Mississippi River), and Tennessee during the year ending June 1, 1904.
>
> Second. To inquire into and ascertain whether the prices set by them were observed, and
>
> Third. To enforce adherence to the prices.

As soon as it was organized, the Colonial Development Co. (Ltd.) entered into contracts with each of the parties to the agreement, which contracts provided that each company should be allowed the same percentage of total sales in these States that it had enjoyed during the year ending June 30, 1903. If it should sell more than this allotment, it was to be penalized; if it should sell more than 75 per cent of its allotment but less than 100 per cent, it should receive a rebate for the proportion which it failed to sell, amounting to $1.50 per ton for ammoniated goods and $1 for alkaline goods and acid phosphate. The 75 per cent minimum was inserted to lessen the advantage which a company might obtain by overstating its sales for the year 1903.

Each company which was party to the agreement was required to deposit with the Colonial Development Co. a sum amounting to 20 cents a ton upon its allotment, which sum was to be returned to the company at the end of the fertilizer year, provided that it had maintained the fixed prices. In case any company did not maintain the established prices, it forfeited this sum to the Colonial Development Co.

The capital stock of the Colonial Development Co. was $50,000, divided into 5,000 shares of the par value of $10 each, 4,763 shares of which were subscribed for upon its organization and 10 shares during the following year. The agreement provided that each of the contracting parties should receive this stock at the rate of 3 shares for each 1,000 tons of fertilizer allotted. The Virginia-Carolina Chemical Co., under this arrangement, held 2,620 shares, or considerably more than half. It also had two out of the five directors of the Canadian corporation.

There were various other provisions contained in these contracts between the Colonial Development Co. and the various parties to the agreement, but they were relatively unimportant; in some cases they were intended really to serve as a cloak to hide the real purpose of the agreement. For example, the first and second articles provided that the Colonial Development Co. should purchase a certain quantity of fertilizer from the contracting party, to be delivered at such places and in such manner as it should direct and at a price which should be the current reasonable market price for such fertilizer, while the third article provided that in case the Colonial Development Co. notified the contracting party that it would not purchase the quantities of fertilizers specified in articles 1 and 2, it should endeavor to dispose of these quantities through other purchasers at the current reasonable market prices. It was never intended that the Colonial Development Co. should actually purchase any fertilizer from the contracting parties, and it never did make such purchases.

A number of fertilizer companies doing business in the Southern States did not sign the original agreement. Some of these later joined the combination after receiving a more favorable allotment than was originally offered. A few important concerns did not enter the combination at all. Among these were The American Agricultural Chemical Co. and Swift & Co. It appears, however, that practically all such companies respected the prices charged by the parties to the combination, so that very little, if any, competition was encountered from the independent wet mixers. The dry mixers were handicapped in competing against the combination, because they were obliged to purchase their acid phosphate from the wet mixers who were parties to the agreement at the regular list prices, which were the same for large or small quantities. They were also at a disadvantage in the purchase of potash salts, since only a few of them did a large enough business to enable them to purchase their potash directly from the German Kali Works (see p. 119) at the wholesale price, 500 tons being the minimum for such sales. These independent dry mixers were not handicapped in respect to their requirements of cottonseed meal, because their mixing plants were generally connected with cotton-oil mills, but their advantage in respect to this material was not sufficient to offset the disadvantage experienced in regard to these various other materials which they used.

Price lists were prepared and distributed to local dealers in the seven Southern States, stating the prices to be charged for ammoniated and alkaline mixtures, as well as for acid phosphate, nitrate of soda, kainit, etc., and the discounts to be allowed for cash. It has been said that these price lists were gotten up by the sales department of the Virginia-Carolina Chemical Co., which owned the majority stock of the Colonial Development Co. The 1904 price lists showed a substantial advance over the prices in effect in 1903, and the prices in 1905 were practically the same as the 1904 prices. A committee was assigned the task of running down any case of price cutting by parties to the agreement, and was very active in this work, but in spite of their vigilance some secret rebating is said to have taken place.

In 1906 suit was brought against the parties to this price-fixing combination for conspiracy in restraint of interstate trade and commerce in violation of the Sherman Antitrust Act. Some 30 fertilizer companies, 2 firms, and about 25 individuals were indicted on May 25, 1906, by the grand jury in the Circuit Court of the United States for the Middle District of Tennessee. After two years of litigation the Government's suit was quashed on the ground that two special assistants to the United States attorney were present and participated in the proceedings of the grand jury which indicted the defendants. The statute of limitations became effective three days prior to the quashing of the indictment, which occurred on July 3, 1908, so that the case could not be reopened, but the combination was effectively broken up as the result of the suit.

Section 17. Present tendencies.

Since the breaking up of the price-fixing combination above referred to competition in the fertilizer industry has increased rapidly. The large profits of the year 1910 caused a marked increase in the number of concerns engaged in the business, especially in the Southern States. As a result but few, if any, of the fertilizer-manufacturing plants now in operation are working up to their full capacity. In 1913 several up-to-date plants were not operated at all. The excess plant capacity leads to overproduction and price cutting. The bulk of a factory's output, especially in the South, must be marketed during the first three months of the year, otherwise stocks must be carried over until the following year. According to one large manufacturer this places tremendous pressure upon factory managers to get their goods out rapidly. Some particular manufacturer who is overstocked gets nervous and begins to cut prices in order to hasten deliveries. Competitors are obliged to make corresponding reductions in order to hold their trade, with the result that demoralization of prices often results. Few of the large number of fertilizer concerns have an adequate system of cost accounting, so that they do not know when they are selling below cost. The following statement on this point was made in The American Fertilizer for August 22, 1914:

> Indeed, it is believed that possibly 50 per cent of the tonnage of commercial fertilizers manufactured in this country are made by manufacturers who have very little idea of the actual cost of the materials, labor, overhead expense, selling expense, etc., that enter into the production of a ton of fertilizers.

About the year 1910, also, the policy of The American Agricultural Chemical Co. and the Virginia-Carolina Chemical Co., in keeping out of each other's territory, appears to have been abandoned. The former invaded the South, while the latter in 1912 and 1913 invaded the northern territory, establishing factories at Cincinnati, Ohio, and Carteret, N. J. Since 1910 the F. S. Royster Guano Co. has also invaded the northern territory by building a large new plant in Baltimore. On account of this increase in competition any attempt to control the prices of mixed goods to-day would be much more difficult than it was in 1903 and 1904.

Control of materials.—As has already been pointed out (see pp. 181 to 211), the large fertilizer manufacturers, since their organization, have secured and extended their control over various raw materials. The purpose of the Virginia-Carolina Chemical Co. in taking over the Southern Cotton Oil Co. was to secure supplies of an important source of nitrogen. The American Cotton Oil Co. also enjoys an advantage in respect to cottonseed meal. The American Agricultural Chemical Co. is in the rendering and degreasing business on a considerable scale. It collects butcher-shop fats, suet, bones, etc., and also abattoir refuse, from which it obtains, after rendering, some of its tankage. The packers also have an important advantage in respect to animal ammoniates, since they are the largest producers of these materials. They have also secured control of a considerable number of cotton-oil mills.

Two fertilizer companies, the International Agricultural Corporation and the Virginia-Carolina Chemical Co., a few years ago obtained an interest in potash mines in Germany, but the German potash law of 1910 (see p. 110) made it impossible to secure potash salts for less than the fixed price. Recently The American Agricultural Chemical Co. obtained concessions in Spain, where deposits of potash salts have been discovered.

The greatest control of the fertilizer manufacturers over materials is in the production and sale of acid phosphate, due to ownership of extensive deposits of phosphate rock and also of almost all of the plants for manufacturing acid phosphate. It does not appear, however, that this control has resulted in higher wholesale prices, although retail prices for credit transactions often appear to be unreasonably high (see p. 166).

The success of the independent dry mixers, which are the greatest competitors of the large concerns, and also the profitableness of the practice of home mixing, depend upon the ability to secure acid phosphate and other materials at wholesale prices. Prior to the outbreak of the European war cottonseed meal, nitrate of soda, sulphate of ammonia, and potash salts could be obtained by the dry mixers and farmers who were able to pay cash at prices which were but little higher than those paid by the large concerns, and owing to overproduction of bulk acid phosphate the wholesale price of this material, as compared with the cost of production, was very reasonable. This indicates that the large fertilizer manufacturers did not have sufficient control of raw materials to eliminate competition and raise prices.

The European war has had an important effect upon the fertilizer industry. The consumption of fertilizers has decreased and numerous local dry mixers have closed up their plants temporarily at least. While the abnormal conditions last, the large manufacturers will occupy a position of advantage. What the situation will be when normal conditions are again restored can not be foreseen.

INDEX.

Page.
- Abbatoirs, packers, locations of five large, 68
- Abbot Manufacturing Co., identification of, 206
- Acid phosphate:
  - Consumption in 1913, 170
  - Cost of production at certain plants, 91–93
  - Description of, 88–89
  - Manufacture, process of, 89–90
  - Overproduction, effect on prices of, 16, 154
  - Prices, 151–152, 165–167
  - Producers, principal, 90
  - Production by seven large fertilizer companies in 1913, 91
    - Total estimated, 1913, 91
  - Sales and consumption by seven large companies, 94
  - Sales, bagged and bulk, by seven large companies, 173
  - Used by seven large companies, 1913, 174
- Acme Manufacturing Co, 213
- Advancing merchant, method of doing business, 238
- Affiliated fertilizer companies:
  - Identification of, 11, 181, 184, 188, 194, 199, 201, 205, 209, 211, 212–214
  - Operations of, 10, 11, 15, 179–181, 217
  - Policy of acquiring, 10, 217
- Agreements:
  - In restraint of trade, 240–243
  - To restrict output of nitrate of soda, 23–25
- Agricultural credits, high interest rates on, 215
- Agricultural Investment Corporation, subsidiary of International Agricultural Corporation, 204
- Agricultural Supply Co., identification of, 201
- Air nitrates:
  - Distribution of, 36
  - Manufacture of, etc, 32–36
- Alabama:
  - Brands, number registered, 1914, 219
  - Cottonseed meal prices, 1907–1914, 139–140
  - Fertilizer plants, by classes, 1914, 190
  - Fertilizer sales, by certain companies and total, 1914, 176
- Alabama Chemical Co, 214
- Alexandria Fertilizer & Chemical Co., subsidiary of the American Agricultural Chemical Co, 195, 196
- Alkaline mixtures:
  - Consumption in 1913, 170
  - Sales by seven large companies, 1913, 173
- Altamaha Fertilizer Co., identification of, 206
- Amalgamated Phosphate Co, 211

American Agricultural Chemical Co., The: Page.
  Basic slag, imports of, 1913 87
  Brands—
    Number of certain formulas, South Carolina, 1913-14 220
    Number registered in certain States, 1913-14 218-219
    Number registered in New York, 1913 198
    Number registered in Vermont, 1914 (footnote) 222
  Companies, constituent and acquired 192-194
  Fertilizer materials used in 1913 173-174
  Goodwill account 192
  Identification of inactive subsidiaries 199
  Identification of subsidiary and affiliated companies 194
  Nitrate of soda imports 30-31, 129
  Plants—
    Acid phosphate 90
    Location of 175
    Number and character of, by States, 1914 195-196
    Number in United States, by classes, 1914 179
    Number operated in four States, by classes, 1914 190
    Rendering 69, 200
  Organization and capitalization 172, 191-192
  Phosphate properties 99, 100, 192, 199
  Potash contracts 116
  Price lists adopted by other companies 216
  Sales, bagged and bulk goods, 1913 173
    In four States, 1914 176
  Selling companies 10, 180, 194, 197
  Spanish potash concessions 244
  Sulphate of ammonia producer 42
  Tankage, purchases of, in 1913 149
American Agricultural Chemical Co. of Delaware, The, plants operated by 196
American Agricultural Chemical Co. of Florida, The, plants operated by 196
American Coal Products Co.:
  Contracts, exclusive 49-52
  Corporate organization 51-52
  Exclusive selling agent 7
  Influence of, on prices of sulphate of ammonia 138
  Sales of sulphate of ammonia by 49-51
  Sales policy 52-53
American Cotton Oil Co.:
  Fertilizer business of 212
  Oil mills and mixing plants 62
  Organization, capitalization, etc 61
American Cyanamid Co., The, organization and capitalization 34-35
American Fertilizing Co., subsidiary of Virginia-Carolina Chemical Co 182, 184
American importers of nitrate of soda 30-31
American Phosphate Mining Co., phosphate rock properties 199
American Trona Co., potash salts 105
Americus Home Mixture Guano Co., identification of 205
Ammonia liquor:
  Relative production of liquor and sulphate 43
  Sales by American Coal Products Co 51
  Use of 39-43

Ammoniated fertilizers: Page.
  Consumption in 1913.......... 170
  Sales by seven large companies in 1913.......... 173
Ammoniated Humus Co., affiliated with Virginia-Carolina Chemical Co.......... 191
Ammoniates, prices per unit of nitrogen.......... 156–160
Ammonium sulphate. (*See* Sulphate of ammonia.)
Ammo-Phos Corporation, affiliated with Virginia-Carolina Chemical Co.......... 191
Analysis of fertilizers.......... 13
Anderson Fertilizer Co., identification of.......... 205
Animal food, tankage used as.......... 73
Antwerp:
  Spot prices of nitrate of soda, 1906–1914.......... 123–124
  Spot prices of sulphate of ammonia, 1907–1914.......... 131–132
Apatite, production of.......... 96
Argentina, American packers in.......... 68
Arkansas, prices of cottonseed meal, 1907–1914.......... 139–140
Armour & Co., violation of Texas antitrust act by.......... 65–66
  Interest in cotton-oil mills.......... 64
Armour Fertilizer Works:
  Brands—
    Number of certain formulas, South Carolina, 1913–14.......... 221
    Number registered in certain States, 1913–14.......... 218–219
  Companies controlled through intermediaries.......... 202
  Fertilizer materials used in 1913.......... 173–174
  Identification of subsidiaries.......... 201
  Imports of nitrate of soda.......... 30–31, 129
  Organization and capitalization.......... 172, 200
  Phosphate properties.......... 99, 100, 203
  Plants—
    Acid phosphate.......... 90
    Number in United States, by classes, 1914.......... 179
    Number operated in 1914, by classes and by States.......... 202
    Operated in Alabama, Georgia, South Carolina, by classes, 1914.......... 190
  Potash contract.......... 116
  Producer of tankage, etc.......... 67
  Purchasers of tankage, etc.......... 150
  Sales, bagged and bulk, 1913.......... 173
    In four States, 1914.......... 176
  Selling companies.......... 180
  Subsidiary local dry mixers.......... 10, 180, 181, 200, 201, 202
Aroostook Warehouse Co., subsidiary of The American Agricultural Chemical Co. 200
Ashepoo Fertilizer Co., acquired by The American Agricultural Chemical Co.. 194
Asociacion Salitrera de Propaganda. (*See* Nitrate Propaganda Association.)
Association of Chesapeake Bay fish scrap factories.......... 85
Atlantic Chemical Corporation, identification of.......... 209
Atlantic Packing Co., identification of.......... 211
Atlantic Phosphate & Oil Corporation.......... 84–85
Atlas Phosphate Co., subsidiary of International Agricultural Corporation.......... 208
Atmospheric nitrogen, processes for fixation of.......... 32
Auction sales of nitrate lands.......... 21
Austria-Hungary, potash deposits in.......... 106

Page.
Badische Anilin-und-Sodafabrik........ 38
Baker & Bro., H. J.:
  Importer of nitrate of soda........ 30–31
  Merchants and brokers of sulphate of ammonia........ 53
Balfour, Guthrie & Co., nitrate imports, 1913........ 31
Balfour, Williamson & Co........ 30
Barker Chemical Co........ 214
Barrett Manufacturing Co., subsidiary of American Coal Products Co........ 51
Base goods........ 76–79
Basic slag phosphate:
  By-product of basic Bessemer process........ 86
  Importations of........ 87
  Source of phosphorus........ 5
  World's production, by countries........ 87
Baugh & Sons Co.:
  Brands—
    Number of certain formulas, South Carolina, 1913–14........ 221
    Number registered in certain States, 1913 and 1914........ 218–219
  Fertilizer materials used in 1913........ 173–174
  Organization, capitalization, etc........ 172, 211
  Plants—
    Acid phosphate........ 90
    Number of, by classes, 1914........ 179
    Rendering........ 69
  Sales, bagged and bulk, 1913........ 173
    In four States, 1914........ 176
  Sulphate of ammonia producer........ 42
Beet-sugar industry, influence on prices of nitrate of soda, etc........ 28, 125–126
Belgium, consumption of nitrate of soda in........ 29
Bencini, C. H., cotton-oil mills........ 63–64
Berkeley Chemical Co., The, identification of........ 195
Birmingham Fertilizer Co., identification of........ 184
Blackstone Guano Co., identification of........ 184
Blast furnaces, sulphate of ammonia from........ 39
Blue phosphate rock deposits, location of........ 99
Bolivia, nitrate lands of........ 21
Bone carbonizing works, sulphate of ammonia from........ 37, 39
Bone products in fertilizers........ 88
Bones, source of phosphorus........ 5
Book investment, four large companies, 1910–1914........ 228–230
Booking date, potash salts........ 118
Bowker Chemical Co., subsidiary of The American Agricultural Chemical Co.. 200
Bowker Fertilizer Co., subsidiary of The American Agricultural Chemical Co. 194, 195
Bowker Insecticide Co., subsidiary of The American Agricultural Chemical Co. 200
Bradley potash contracts........ 109
Bragaw Fertilizer Co., identification of........ 184
Brands:
  Multiplication of........ 11, 218–223
  Number of certain formulas registered in South Carolina, 1913–14........ 220–221
  Registered in New York, 1913, by The American Agricultural Chemical Co. 198
  Registered in Vermont, 1914 (footnote)........ 222
  Registration taxes........ 14
Brands, good will, etc., of acquired companies, value of........ 180

Page.

Brokers in fertilizer materials ... 7
Brokers' prices of materials ... 120, 133, 138, 144–145, 151
Brown phosphate rock deposits, location of ... 99
Bryant Fertilizer Co., subsidiary of Virginia-Carolina Chemical Co ... 182, 184
Buckeye Cotton Oil Co., organization, etc ... 62
Buena Vista Home Mixture Guano Co., identification of ... 206
Bullochville Home Mixture Guano Co., identification of ... 205
Buquo Lime Co., G. C., subsidiary of The American Agricultural Chemical Co. 200
Burlington Rendering Co., identification of ... 211
By-product coke ovens:
  Principal source of sulphate of ammonia in United States ... 37
  Types of ... 40

Cable advices on sulphate of ammonia prices ... 131–132
Calcium cyanamid. (*See* Cyanamid.)
Caliche, decline in quality mined ... 21
  Deposits of ... 18
  Fuel cost in refining ... 21
Canada, exports of sulphate of ammonia to United States ... 45
Carnallit, crude potash salt ... 105
Caraleigh Phosphate & Fertilizer Works ... 213
Catawba Fertilizer Co., identification of ... 206
Central Georgia Guano Co., identification of ... 184
Central Leather Co., production of tankage ... 77
Chamber process, sulphuric acid ... 102
Charleston, cash prices of fertilizer materials to farmers and merchants... 163, et seq.
Charleston (S. C.) Mining & Refining Co., subsidiary of Virginia-Carolina Chemical Co ... 182, 183, 190–191
Charlotte Harbor & Northern Railway Co., subsidiary of The American Agricultural Chemical Co ... 200
Charter rates, influence on prices of nitrate of soda ... 27, 125–128
Chattahoochee Fertilizer Co, identification of ... 205
Chemical Works Schonebeck (Ltd.), affiliated with Virginia-Carolina Chemical Co ... 191
Cherokee Fertilizer Co., identification of ... 206
Chesapeake Bay Fish Scrap Factories, Association of ... 85
Chesapeake Chemical Co., identification of ... 213
Chickamauga Fertilizer Co ... 214
Chile:
  Nitrate deposits, description of ... 18
  Nitrate exports ... 22
  Nitrate propaganda ... 21, 25
  Prices of nitrate lands ... 21
  Prices of nitrate of soda, 1906–1914 ... 123–124
Chipley Home Mixture Guano Co., identification of ... 205
Cincinnati Phosphate Co., The, identification of ... 213
Cleveland Provision Co ... 68
Cochrane Chemical Co., sulphate of ammonia producer ... 38, 42
Coe-Mortimer Co., The, subsidiary of The American Agricultural Chemical Co ... 194, 195, 196
Coke ovens, by-product ... 37, 40
Coking process, description of ... 38
Colonial Development Co. (Ltd.), organization, etc ... 240–243
Colonial Fertilizer Co., identification of ... 211
Columbia Guano Co., identification of ... 209

Page.
Combahee Fertilizer Co 214
Combinations, of cotton-oil mills 144
  Of nitrate producers 23–25
Commerce Fertilizer Co., identification of 184
Commission men 215
Commissions, brokers' 8, 59, 74, 83, 138
  Received by American Coal Products Co 52, 138
Comparison of cash and credit prices of fertilizer materials .... 162 et seq.
Comptoir Belge du Sulfate l'Ammoniaque 47
Concentrated tankage, fertilizer material 67
  Estimated domestic production 70–72
Congaree Fertilizer Co., identification of 206
Consignment contracts 216
Consolidated Gas Co., sulphate of ammonia producer 42
Consolidated Rendering Co.:
  Brands registered in Vermont, 1914 (footnote) 222
  Controlled by Swift interests 69
  Organization and capitalization 210
  Plants, location and character of 210–211
  Selling companies 180, 211
Consumers' Chemical Corporation:
  Identification of 184–185
  Organized by Virginia-Carolina Chemical Co 183
Consumers Cotton Oil Co., subsidiary of F. S. Royster Guano Co 209
Consumption, commercial fertilizers by States, 1909–1914 171
  Nitrate of soda, by years, 1904–1913 22
  Nitrogenous materials, 1913 175
  Potash salts, by classes, 1904–1914 115
  Principal fertilizer materials 5–6
  Sulphate of ammonia in United States 45–46
Contact process, sulphuric acid 102
Continental Fertilizer Co., identification of 201
Contracts:
  Cancellation of American potash 112–113
  Consignment 216
  Potash 116
  Tankage 150
  Terms of, etc 216–217
Controlled companies operated as independents 10, 11, 15, 179–181, 217
Cooperative buying, by farmers' clubs 237
Coosa River Fertilizer Co., identification of 184–185
Cope & Co., Josiah, identification of 195
Corn crop, by years, 1907–1914 141
Corn prices, relation to cottonseed meal prices 141
Cost accounting, need of adequate system of 15, 243
Cost of production, acid phosphate 91–93
  Cyanamid 34
  Muriate of potash, 1901–1909 109–110
  Nitrate of soda 19–21
Costs, sales, and profits of large manufacturers 11, 223–230
Cotton crop, by years, 1907–1914 141
Cotton oil mill combinations, influence on prices 144

Page.

Cotton-oil mills:
  Agreements, restraint of trade in 65–66
  Concentration of ownership 60
  See also various companies.
Cotton prices:
  Influence on demand for nitrate of soda 28
  Relation to cottonseed meal prices 141
Cotton States Fertilizer Works, identification of 210
Cotton States Seed & Fertilizer Co., leased to International Agricultural Corporation 207
Cottonseed meal:
  Consumption for fertilizer, estimated 58, 175
  Exports, 1907-1914 58, 141
  Fertilizing value 55
  Laboratory tests 56
  Prices, influence of, on prices of animal ammoniates 148–150
  Prices per unit of nitrogen, 1909–1914 157–158
  Process of manufacture 56–57
  Production, by years 58, 141
  Sale of 58–60
  Standardization of product 59
  Used by seven large companies, 1913 173
  Uses of 56
  Wholesale prices of 138–140
Coweta Fertilizer Co., subsidiary of Virginia-Carolina Chemical Co 183, 184
Craven Chemical Co., identification of 184
Credit conditions 9, 16, 215
Credit risks, distribution of 10, 180
Credit system, rural 16, 215, 237–240
Cross & Sons, Alexander, exporter of sulphate of ammonia 48
Crude potash salts. (*See* Potash salts.)
Cudahy Packing Co., The, producer of tankage, etc 67
Cumberland Fertilizer Co., The, identification of 206
Cuthbert Home Mixture Guano Co., identification of 205
Cyanamid:
  Consumption of fertilizer, estimated domestic, 1913 175
  Cost of manufacture 34
  Description of 33
  Plants, location of 34
  Process of production 17, 33
  Protection by American Cyanamid Co 35
  Source of sulphate of ammonia 40
  Used by seven large companies, 1913 173
  Uses of, in United States 33

Darling & Co 68, 150
Davisboro Fertilizer Co., The, identification of 206
Davison Chemical Co., sulphuric acid producer 103
Dawson Home Mixture Guano Co., identification of 205
Dayton Gas Co., sulphate of ammonia producer 42
Decatur Fertilizer Co., identification of 206
Delegacion Fiscal de Salitreras 21
Deutsch Ammoniak-Verkaufs-Vereinigung 47
Discounts allowed dealers 215–217
  On large potash contracts 116–118

Page.
Distributors of fertilizer materials 9, 162
Dodge Fertilizer Co., identification of 206
Dold Packing Co., Jacob 68
Dothan Chemical Co 214
Dothan Guano Co., identification of 184
Dried blood:
  Consumption for fertilizer, estimated domestic, 1913 175
  Description and process of production 66–67
  Imports of 69
  Prices per unit of nitrogen, 1909–1914 157–158
  Prices, wholesale 146
  Production, estimated domestic 70–72
  Purchases by large packers 72
  Terms of sale, etc 74–76
  Uses 72–73
"Dried Stick," description of 67
Dry mixers. (*See* Mixers.)
Du Pont de Nemours Powder Co., E. I 8, 23, 30–31
Du Pont Nitrate Co 23
Ducktown Sulphur, Copper & Iron Co. (Ltd.):
  Sulphuric acid producer 103
  Sulphuric acid contract with International Agricultural Corporation 204
Dunkirk, spot prices of nitrates of soda, 1906–1914 123–124

Ehle, L. C., cotton-oil mills 64
Elements of plant food 3
Ellaville Guano Co., identification of 206
Empire Carbon Works, subsidiary of The American Agricultural Chemical Co. 195–196
Empire Cotton Oil Co 62, 63, 214
Empire Guano Co., identification of 212
Empire State Chemical Co 214
England, exports of sulphate of ammonia to United States 45
English interest in nitrate exports 22
Essex Fertilizer Co., identification of 211
Etiwan Fertilizer Co 213
Export tax on nitrate of soda 20–21

Farmer Co., W. S., subsidiary of The American Agricultural Chemical Co 194, 195
Farmers' Cooperative Fertilizer Co., identification of 201
Farmers' Cotton Oil Co 213
Farmers' clubs and unions, cooperative buying by 237
Farmers' Fertilizer Co., identification of 206
Farmers' Guano Co 213
Federal Chemical Co.:
  Miner of Tennessee phosphate rock 100, 213
  Selling companies 180, 213
Fertilizer concerns, number of 9, 170
Fidelity Chemical Corporation, identification of 184–185
Fiscal commission of nitrate lands 21
Fish scrap:
  Concentration of factories 84
  Description of 79
  Consumption, 1913 175

Fish scrap—Continued. Page.
- Factories, list of 80–81
- Prices per unit of nitrogen, 1909-1914 157–158
- Process of production 81
- Producers 79–80
- Production of 82
- Speculation in 83–84
- Terms of sale 83
- Use of 83
- Used by seven large companies, 1913 173
- Wholesale prices 147

Fletcher Guano Co., identification of 205

Florida Mining Co., subsidiary of International Agricultural Corporation 204
- Phosphate rock properties 207

Florida Phosphate Mining Co., subsidiary of F. S. Royster Guano Co 209

Florida phosphate rock, description of deposits 97
- Miners of 97–98
- Production by years, 1904–1914 95–96

Folsch & Co., nitrate exports of, by years, 1910–1913 26

Foreign tankages, competition from 150–151

Fox Chemical Co., identification of 213

France:
- Consumption of nitrate of soda in 29
- Sulphate of ammonia, production and sale in 46–47

Frisbie Co., L. T., identification of 211

Fuel cost in refining caliche 21

Furman Farm Improvement Co 214

Future contracts, nitrate of soda 129

Gas Machinery coke ovens, number in operation, 1914 40–41

Gas works, source of sulphate of ammonia 38

General Chemical Co., sulphuric-acid producer 103

Georgia:
- Brands registered, number of, 1914 219
- Cottonseed meal prices, 1907–1914 139-140
- Fertilizer plants, by classes, 1914 190
- Fertilizer sales by certain companies and total, 1914 176
- Sales of fertilizer materials—
  - By seven largest companies, 1914 161–162
  - Distribution of, 1914 161

Georgia Chemical Works, subsidiary of Virginia-Carolina Chemical Co 183, 184

Georgia Fertilizer Co., leased to International Agricultural Corporation 207

German-American Coke & Gas Co., organization, etc 52

German Kali Works, potash agency 119

Germany:
- Interest in nitrate exports 22
- Nitrate of soda, consumption in 1909–1913 29
- Potash Syndicate 2, 7, 108, 109–110
- Potash law of May 25, 1910 2, 110–112
- Sulphate of ammonia—
  - Exports of, to United States 45
  - Production 38, 46–47

Gewerkschaft-Einigkeit, affiliated with Virginia-Carolina Chemical Co 191

Page.

- Gibbs & Co., Antony:
  - Exports of nitrate from Chile, by years, 1910–1913 26
  - Importer of nitrate of soda 8, 30
  - Propositions to nitrate producers 25
- Globe Fertilizer Co., identification of 213
- Globe Rendering Co 68
- Grace & Co., W. R.:
  - Importer of nitrate of soda 8, 30–31
  - Nitrate of soda—
    - Control of prices 129
    - Exports from Chile, 1910-1913 26
  - Organization, capitalization, etc 31
  - Steamers owned and chartered by 27
- Grasselli Chemical Co., The:
  - Location of fertilizer plants, etc 214
  - Sulphuric-acid producer 103
- Greenwood Fertilizer Co., identification of 205
- Griffith & Boyd Co 213

- Hamburg:
  - Spot prices of nitrate of soda, 1906–1914 123–124
  - Spot prices of sulphate of ammonia, 1907–1914 131–132
- Hampton Guano Co., The, identification of 195
- Hard phosphate rock:
  - Location of deposits 97
  - Miners of 98
- Hartsalz:
  - Crude potash salt 105
  - Used by seven large companies, 1913 174
- Hartsville Fertilizer Co., identification of 206
- "Henson Mills," organization, etc 63
- Hess & Bro., S. M. (Inc.), identification of 195
- Home Guano Co., identification of 184
- Home mixed fertilizers, prices compared with ready-mixed, South Carolina and Georgia, 1914 232–233
- Home mixing 9, 15, 46, 230–237
- Home Mixture Guano Co., subsidiary of International Agricultural Corporation 204, 205
- Hoover & Mason, miners of Tennessee phosphate rock 100
- Hope Fertilizer Co., identification of 201
- Hopkins Fertilizer Co., affiliated with Read Phosphate Co 212
- Hubbard Fertilizer Co 213

- Identification of subsidiary and affiliated companies 11, 181, 217
  - American Agricultural Chemical Co., The 194
  - Armour Fertilizer Works 200–201
  - Consolidated Rendering Co 211
  - Farmers Guano Co 213
  - Federal Chemical Co 213
  - Hubbard Fertilizer Co., The 213
  - International Agricultural Corporation 205
  - Jarecki Chemical Co., The 213
  - Morris Fertilizer Co 214
  - Read Phosphate Co 212
  - Richmond Guano Co 213
  - Royster Guano Co., F. S 209
  - Virginia-Carolina Chemical Co 184

Page.

Imperial Co., The, identification of........ 195
Importers of fertilizer materials........ 8
Improved Guano Co., identification of........ 206
Independent Guano Co., identification of........ 184
Independent Packers' Fertilizer Co., affiliated with Read Phosphate Co........ 212
Industrial Cotton Oil Properties, organization of........ 61
Interest rates on short-time loans........ 16, 237
International Agricultural Corporation:
  Brands—
    Number of certain formulas registered in South Carolina, 1913–14........ 221
    Number registered in certain States, 1913–14........ 218–219
  Control of affiliated dry mixers........ 10, 180, 204–206
  Fertilizer materials used in 1913........ 173–174
  Identification of subsidiary and affiliated companies........ 205–206
  Organization and capitalization........ 172, 203
  Phosphate rock properties........ 99, 100, 204–207
  Plants—
    Acid phosphate........ 90
    Number of, in United States, by classes, 1914........ 179
    Operated in Alabama, Georgia, South Carolina, by classes, 1914........ 190
    Rendering........ 69
  Policy of acquiring interest in local dry mixers........ 180
  Potash contract........ 116
  Potash properties........ 208
  Sales of, bagged and bulk goods, 1913........ 173
    in four States, 1914........ 176
  Selling companies........ 180, 205
  Subsidiary and affiliated fertilizer companies........ 204–206
  Sulphuric acid contracts........ 103, 204
Interstate Chemical Corporation........ 214
Interstate Cotton Seed Crushers Association........ 59

Jarecki Chemical Co., The:
  Plants........ 213
  Selling companies........ 180, 213
Jefferson Fertilizer Co........ 214
Jones Fertilizer Co., identification of........ 201
Joslin-Schmidt Co., The, tankage........ 77

Kainit, crude potash salt........ 105
  Used by seven large companies, 1913........ 174
Kaliwerke Sollstedt Gewerkschaft, affiliated with International Agricultural Corporation........ 203, 208
Kanona Co., Inc., The, tankage........ 77
Kaufman Fertilizer Co., The, indentification of........ 213
Kentucky Fertilizer Co., identification of........ 213
Kingan & Co. (Ltd.)........ 68, 150
Klönne coke ovens, number in operation, 1914........ 40–41
Knyvetta Dock & Warehouse Co., subsidiary of The American Agricultural Chemical Co........ 200
Koppers coke ovens, number in operation, 1914........ 40

Labor, increased demand for, in Chile........ 20
Labor troubles:
  Effect on prices of nitrate of soda........ 126–127
  Effect on prices of sulphate of ammonia........ 126–127, 136

Page.
Land pebble phosphate rock, miners of........ 97-98
Lawrenceville Fertilizer Co., identification of........ 206
Laws, State fertilizer control........ 12-13
Lille, spot prices of sulphate of ammonia........ 131-132
Lister's Agricultural Chemical Works of N. J.:
  Affiliated with The American Agricultural Chemical Co........ 193, 195
  Plant operated by........ 196, 200
Liverpool:
  Spot prices of nitrate of soda, 1906-1914........ 123-124
  Spot prices of sulphate of ammonia, 1907-1914........ 131-132
Loans, interest rates on short time........ 16, 237
Local dry mixers, control of, by large companies........ 10, 180
Louisville Fertilizer Co., identification of........ 201
Lowell Fertilizer Co., identification of........ 210-211
Ludlum Co., Frederick, identification of........ 195
Lumpkin Home Mixture Guano Co., identification of........ 205

Macon Fertilizer Works, identification of........ 201
Macmurphy Co., The, identification of........ 185
Manchester Exchange, sulphate of ammonia dealt in on........ 47
Manchester Rendering Co., identification of........ 211
Manipulators. (*See* Mixers.)
Manufacturing costs, four large companies, 1910-1914........ 223-228
Manure salts:
  Grades of........ 107
  Used by seven large companies, 1913........ 174
Marietta Fertilizer Co., identification of........ 201
Martin & Co., D. B........ 68
Materials:
  Control of, by large companies........ 244
  Description of........ 3-5, 17, 55, 86, 104
  Miscellaneous total consumption in 1913........ 5-6, 170
    Consumption by seven large companies........ 173-174, 175
  Purchase of by dry mixers........ 11, 244
  Sales of........ 161-168
Maysville Guano Co., identification of........ 184
Menhaden industry, list of factories........ 80-81
  (*See also* Fish scraps.)
Merchant, advancing, method of doing business........ 238
Merchants Line, owned by W. R. Grace & Co........ 31
Meridian Fertilizer Factory, organization, etc........ 212
Meyer, Wilson & Co., nitrate imports, 1913........ 31
Middlemen, kinds of........ 6
  Sales to, etc........ 214-215
Millen Fertilizer Co., identification of........ 206
Miller Fertilizer Co........ 213
Miller & Son Co., James........ 48
Miners of phosphate rock........ 97-100
Mississippi:
  Cotton-oil mill combinations........ 144
  Cottonseed-meal prices, 1907-1914........ 139-140
Mixed fertilizers, consumption of........ 170, 171
  Prices........ 2-3, 230-236
  Sales by seven large companies........ 170, 173

Mixers, dry: Page.
  Control of, by large companies........................ 10, 11, 15, 179, 181, 217
  Effect on local dealers.............................. 16, 214, 215
  Plants in United States, number, by States, 1914................ 177, 178
    Operated in connection with cotton-oil mills................ 178
Mixers, wet.. 9, 177–178
Mixing, home:
  Economy of.. 9, 230–236
  Labor cost.. 233–236
  Obstacles to.. 236–237
  Propaganda for...................................... 15, 235
Mixing processes, description of.......................... 177
Molony & Carter Co.. 214
Montezuma Fertilizer Co., identification of................ 206
Morrell & Co., John....................................... 68
Morris Fertilizer Co...................................... 214
Morris & Co.:
  Interest in cotton-oil mills............................ 64
  Producer of tankage, etc................................ 67
  Violation of Texas antitrust act by..................... 65, 66
Moultrie Fertilizer & Manufacturing Co., identification of.... 184
Multiplication of brands.................................. 11, 218–223
Muriate of potash, cost of production at certain mines.......... 109, 110
  Used by seven large companies, 1913..................... 174
Muscogee Guano Co., identification of..................... 209
Mutual Fertilizer Co...................................... 214

Nashville, Tenn., acid phosphate, wholesale prices............ 151, 152
Nassau Fertilizer Co., identification of.................. 195
National Chamber Oven Co., coke ovens, number in operation, 1914.......... 41
National Fertilizer Co., The, identification of........... 195
National Utilization Co., The, subsidiary of F. S. Royster Guano Co.......... 77, 209
Nationalization of nitrate industry....................... 24, 25
Navassa Guano Co., subsidiary of Virginia-Carolina Chemical Co........ 182, 183, 184
New England Fertilizer Co., identification of............. 211
New Haven Rendering Co., identification of................ 211
New Jersey, brands registered in, number of, 1913......... 218
New Jersey Zinc Co., sulphuric acid producer.............. 103
New York:
  Brands registered, number of, 1913...................... 218
  Spot prices of nitrate of soda, 1906–1914............... 123, 124
Nitrate Agencies Co., subsidiary of W. R. Grace & Co...... 31
Nitrate Agencies (Ltd.), subsidiary of W. R. Grace & Co... 31
Nitrate companies, number in Chile, 1913.................. 23
Nitrate industry, growth of............................... 21–22
Nitrate lands... 21
Nitrate of ammonia.. 32
Nitrate of lime... 17, 32, 35–36
Nitrate of soda:
  Agreements to restrict production....................... 23–25
  Charter rates, influence on prices...................... 27, 125–128
  Combinations, influence on prices....................... 24
  Competitive conditions in United States markets......... 31–32

Nitrate of soda—Continued. Page.
  Consumption, by industries, estimated 28–29
    For fertilizer, estimated domestic, 1913 .... 28, 175
  Cost of production 19–21
  Demand for, seasonal 28
  Exportation and sale, speculative occupation 27
  Exporters of, principal 26
  Exports, by years, 1907–1913 .... 22, 26–27
  Imports, by companies, 1913 31
    By years, 1909–1913 29
  Interest of various nationalities in exports of 22
  Prices, cash and credit, at certain points 165
    Per unit of nitrogen, 1909–1914 157–158
    Wholesale, 1906–1914 .... 123–124, 164
  Process of mining and refining 18
  Production, 1904–1913 22
  Sales syndicate, proposed 24–25
  Sources of 17–18, 32
  Used by seven large companies, 1913 173
  Visible supply in various markets, 1904–1913 22
Nitrate Propaganda Association 22, 25
Nitrate properties, Chilean, value of, 1909 23
Nitrates, air: Distribution and manufacture of 32–36
  Prices per unit of nitrogen 156–160
Nitrogen:
  Atmospheric, processes for fixation of 32
  Prices per unit, in certain ammoniates and nitrates 156–160
Norfolk, cash prices to farmers and merchants, fertilizer materials .... 163 et seq.
Norfolk Fertilizer Co., The, identification of 195
North Carolina, number of brands registered, 1914 219
  Sales by companies, 1914 176

Ober & Sons Co., G 213
Oberschlesische Kokswerke und Chemische Fabriken A. G 47
Ocmulgee Guano Co., identification of 184
Oconee Fertilizer Co., identification of 206
Ohio, number of brands registered, 1913 218
Oklahoma, cottonseed-meal prices, 1907–1914 139–140
Old Buck Guano Co., identification of 209
Orangeburg Fertilizer Co., identification of 206
Osage Cotton Oil Co 63
Osceola Fertilizer Co., identification of 206
Otto-Hoffman coke ovens, number in operation, 1914 41

Pacific Guano & Fertilizer Co., nitrate imports, 1913 31
Packers Fertilizer Co., The, identification of 213
Packers, influence of, on prices of tankage, dried blood, etc 150
Painter Fertilizer Co., E. O 214
Palmetto Guano Corporation, subsidiary of The American Agricultural Chemical Co 194, 195, 196
Palmetto Phosphate Co., Florida phosphate-rock properties 99, 199
Pamlico Chemical Co., affiliated with F. S. Royster Guano Co 209
Panama Canal, advantage of, in nitrate trade 27
Parmenter & Posley Fertilizer Co., identification of 211
Patagonia, American packers in 68

Page.
Patapsco Guano Co., identification of 195
Pawtucket Rendering Co., identification of 211
Pebble phosphate rock deposits, location of 97
Pennsylvania, number of brands registered, 1913 218
Pennsylvania Salt Manufacturing Co., sulphate of ammonia producer 42
Peoples Fertilizer Co., identification of 206
Personal credits, high interest rates on 16
Peru, nitrate lands of 21
Peruvian Guano Corporation, identification of 184
Phosphate:
  Basic slag, importations of 87
  Principal kinds of 4
  Reverted, description of 89
  Used for fertilizer 86
Phosphate Mining Co., The 90, 214
Phosphate rock:
  Consumption, domestic, 1904–1914 95–96
  Cost of mining 101
  Direct use of 97
  Florida deposits, description of 97
    Miners of 97–98
  Prices 1904–1914 153
  Principal source of phosphorus 94
  Process of mining 100–101
  Production by countries, world's, 1907–1913 96
  Production in United States, 1904–1914 95–96
  Tennessee deposits, description of 99
    Miners of 99–100
Phosphate rock properties:
  American Agricultural Chemical Co 199
  Armour Fertilizer Works 203
  International Agricultural Corporation 204
  Royster Guano Co., F. S 209
  Swift & Co 210
  Virginia-Carolina Chemical Co 191
Phosphorus, sources of 86
Piedmont Mt. Airy Guano Co 213
Pittsburgh Provision & Packing Co 68
Plant food, essential elements of 3
Planters Fertilizer Co., The, identification of 206
Planters Fertilizer & Chemical Co., identification of 201
Planters Fertilizer & Phosphate Co 213
Plants, fertilizer, number of 9, 177–179
  Connected with cotton-oil mills 186–187
Plummer Supply Co., identification of 201
Pocomoke Guano Co., The, subsidiary of The American Agricultural Chemical Co 194, 195, 196
Pollock Fertilizer Co., The, identification of 195
Portland Rendering Co., identification of 211
Potash:
  Availability of 104
  Booking date 118
  Claims, settlement of 113

Potash—Continued. Page.
  Controversy with the United States 112–113
  Cost of production, muriate, average 1901–1909 109–110
  Discounts 117–118
  Essential element of plant food 3, 5, 104
  Five large contracts for 116
  Growth of industry 106
  Importance of industry 105
  Law, 1910 .... 105, 110–112
  Mines, restriction of new 113
  Mining and refining 107
  Muriate, average cost of production at certain mines 109–110
  Propaganda 108
  Sales, 1909–13 107
  Sales in the United States 114–117
  Sources of supply 104–106
  Subcontracts 116
  Sulphate of 107
  Terms of sale 117–118
Potash salts:
  Classification of 5, 108
  Crude, extracted from mines of syndicates, 1890–1913 106
  Extent and description of deposits 105
  Prices of 2, 122, 155, 167–168
  Sales, in the United States on five large contracts in 1913 117
    Through German Kali Works 117
    To chemical companies 117
  Shipments to United States by kinds, 1904–1914 115
  Used by seven large companies, 1913 174
Potash Syndicate:
  Arbitrarily maintains prices of potash 2
  Exclusive selling agent 7
  History of 108
  Prices compared with Schmidtmann prices 109–110
Potassium. (*See* Potash.)
Powhatan Fertilizer Co., identification of 213
Pownal Lime Co., subsidiary of The American Agricultural Chemical Co 200
Prairie Pebble Phosphate Co., subsidiary of International Agricultural Corporation 204, 207, 208
Price cutting by selling companies 181
Price fixing combinations, Colonial Development Co. (Ltd.) 240–243
  Cotton-oil mills 65, 144
Price fluctuations:
  Acid phosphate 153–155
  Causes of, general 120–121
  Cottonseed meal 141–143
  Dried blood, etc 147–150
  Fish scrap 147–150
  Nitrate of soda 125–129
  Phosphate rock 153–155
  Sulphate of ammonia 134–138
  Tankage 147–150

Price lists: Page.
- American Agricultural Chemical Co., adopted by other companies....... 216
- Virginia-Carolina Chemical Co., adopted by other companies............ 215

Prices:
- Acid phosphate—
  - Bulk, f. o. b. various points, 1908–1914.......................... 151–152
  - Bulk and bagged compared, 1914.................................... 165
  - Cash and credit at certain points compared......................... 166–167
- Beet sugar, influence on demand for nitrate of soda.................... 28
- Cottonseed meal—
  - Average monthly, 1907–1914... 138–140
  - Cash and credit at certain points.................................. 169
  - Discussion of fluctuations... 140–144
  - Per unit of nitrogen... 156–160
- Cyanamid.. 35
- Dried blood, 1907–1914.. 146
  - Per unit of nitrogen... 156–160
- Dried fish scrap... 147
  - Per unit of nitrogen... 156–160
- Fertilizer materials.................................. 2, 162–169, 230–236
- Fish scrap.. 145, 147
- Mixed fertilizers... 2–3, 230–236
- Nitrate of soda—
  - Average monthly spot, 1906–1914.................................... 122–124
  - Cash and credit at certain points.................................. 165
  - Discussion of price fluctuations................................... 124–129
  - Domestic, follow prices in Europe.................................. 128
  - Per unit of nitrogen... 156–160
  - Wholesale and distributors' compared, 1914......................... 164
- Phosphate rock—
  - Causes of decline in... 154
  - Florida pebble, at mines, 1908–1914................................ 153
  - Tennessee brown, at mines, 1910–1914............................... 153
- Potash salts—
  - Arbitrarily controlled... 2, 122
  - Comparison of, 1910–1914... 155
  - Comparison of cash and credit...................................... 167–168
- Sulphate of ammonia—
  - Average monthly, f. o. b. plants and Atlantic ports, 1907–1914..... 132–133
  - Discussion of price fluctuations................................... 129–138
  - Domestic, fixed by European market................................ 135
  - Fertilizing value of... 37
  - Foreign, average monthly spot, 1907–1914........................... 131–132
  - Per unit of nitrogen... 156–160
- Tankage... 145, 146
  - Per unit of nitrogen... 156–160

Proctor & Gamble Co., The.. 62

Production:
- Acid phosphate, 1909 and 1913.. 91
- Basic slag phosphate, 1907–1912.. 87
- Concentrated tankage, estimated, 1910–1914............................. 72
- Cottonseed meal, 1902–1914... 58
- Cyanamid.. 34–35
- Dried blood, estimated, 1910–1914...................................... 72

Production—Continued. Page.
- Fish scrap, 1912 and 1913 ... 82
- Nitrate of lime ... 35–36
- Nitrate of soda, 1904–1913 ... 22
- Phosphate rock, 1904–1914 ... 95–96
- Potash ... 106–107
- Sulphate of ammonia—
  - Domestic, 1907–1913 ... 42
  - Germany, France, and United Kingdom, 1908–1913 ... 47
- Sulphuric acid, 1913 ... 103
- Tankage, estimated, 1910–1914 ... 72

Profits of large fertilizer companies, 1910–1914 ... 11, 223–230

Propaganda:
- Nitrate ... 21, 25
- Potash ... 119
- Sulphate of ammonia ... 53–54

Proprietary tankages:
- Description of ... 76–78
- Producers of ... 77

Prussian Government, owner of potash mines ... 105

Putnam Fertilizer Works, identification of ... 184–185

Pyrites, increased cost of, due to European war ... 93
- Use of ... 102

Rainbow Guano Co., identification of ... 206

Rasin Monumental Co., subsidiary of Virginia-Carolina Chemical Co ... 182–183, 184

Rates, charter, influence on prices of nitrate of soda ... 27, 125–128

Read Phosphate Co ... 180, 212

Refuge Cotton Oil Co., subsidiary of Southern Cotton Oil Co ... 186

Registration of brands, etc ... 218–223

Reliance Fertilizer Co ... 214

Resolution of the United States Senate ... 1

Revenue:
- Fertilizer taxes, a source of ... 15
- Nitrate lands in Chile, a source of ... 21
- Nitrate of soda, principal Chilean source of ... 21

Reynolds Home Mixture Guano Co., identification of ... 205

Rhode Island Experiment Station, availability of base goods ... 79

Richland Home Mixture Guano Co., identification of ... 205

Richmond Guano Co ... 213

Roberts-Moss, coke ovens, number in operation, 1914 ... 40

Rochelle Guano Works, identification of ... 184–185

Rock Hill Fertilizer Co., identification of ... 184

Rome Chemical Works, identification of ... 184

Rome Oil & Fertilizer Co., identification of ... 201

Rothberg, coke ovens, number in operation, 1914 ... 40–41

Royster Guano Co., F. S.:
- Brands—
  - Number of, South Carolina, 1913–14 ... 221
  - Number of, registered in certain States, 1913–14 ... 218–219
- Fertilizer materials used in 1913 ... 173–174
- Identification of subsidiary companies ... 209
- Organization and capitalization ... 172, 208–209

Royster Guano Co., F. S.—Continued.
  Plants— Page.
    Acid phosphate 90
    Location and character 209
    Number of, by classes, 1914 179
    Operated in Alabama, Georgia, South Carolina, by classes, 1914 190
  Sales, bagged and bulk goods, 1913 173
    In four States, 1914 176
  Selling companies 180
Royston Guano & Warehouse Co., identification of 184–185
Rural credit system 237–240
Russia, potash deposits in 106

Sailing vessels in nitrate trade 27
St. Bernard Fertilizer Co., identification of 212
Sales:
  Auction, of nitrate lands 21
  Costs and profits of four principal fertilizer manufacturers 223–230
  To farmers direct 10, 214–218
Sales agents:
  Exclusive, for air nitrates 36
  Exclusive for fertilizer materials 7
Sanderson Fertilizer & Chemical Co., subsidiary of The American Agricultural Chemical Co 194, 195, 196
Santa Lucia, orders received at, etc 27
Savannah:
  Bulk acid-phosphate prices f. o. b 151–152
  Cash prices of fertilizer materials 163 et seq.
Schaal-Sheldon Fertilizer Co., identification of 195
Schmidtmann, potash contracts 109–110
  Prices of potash salts 155–156
  Waldemar, interested in International Agricultural Corporation 203
Scotland, sulphate of ammonia exports to United States 45
Seacoast Fertilizer Co., identification of 205
Searles Lake, source of potash 105
Selling companies:
  Common form of subsidiary 180
  Operations of 217
  Use of 10
Selling expense, four large companies, 1910–1914 223–228
Selling methods of fertilizer concerns 10, 214–215
Semet-Solvay Co., coke ovens 38, 40–41
Senate resolution 1
Settlement dates 215
Shale, sulphate of ammonia from 39
Shellman Home Mixture Guano Co., identification of 205
Sinclair & Co. (Ltd.), T. M 68
Smith Agricultural Chemical Co 213
Sodium nitrate. (*See* Nitrate of soda.)
Sons of Plato 65
Soperton Guano Co., identification of 206
South America, American packers in 68
South Atlantic Guano Co., identification of 214

South Carolina: Page.
- Brands, number of certain formulas, registered in 1913–14 season....... 220–221
  - Total number registered, 1914........ 219
- Fertilizer plants, by classes, 1914........ 190
- Phosphate rock, production by years, 1904–1914........ 95–96
- Sales of fertilizer by certain companies and total, 1914........ 176

South Georgia Fertilizer Co., identification of........ 184

Southern Cotton Oil Co.:
- Acquired by Virginia-Carolina Chemical Co........ 182–183
- Identification of........ 184
- Oil mills and dry mixing plants of........ 60, 186–187
- Organization, capitalization, etc........ 60, 186
- Premiums paid in acquiring stock of........ 182

Southern Fertilizing Co., subsidiary of The American Agricultural Chemical Co. 194–195

Southern Refining Co., identification of........ 205

Southern States Phosphate & Fertilizer Co........ 214

Southland Cotton Oil Co........ 65

Spain, potash deposits in........ 106

Speculation in nitrate of soda........ 127

Springfield Rendering Co., identification of........ 211

Standard Chemical & Oil Co........ 214

State-fertilizer-control laws........ 12–13

Steamers in nitrate trade........ 27

Steel Cities Chemical Co., affiliated with Virginia-Carolina Chemical Co....... 191

"Stick," description of........ 67

Storage capacity of large packers for tankage, etc........ 150

Subsidiary and affiliated companies:
- Identification of........ 11, 181, 184, 188, 194, 199, 201, 205, 209, 211, 212, 214
- Operations of........ 10, 11, 15, 179–181, 217
- Purpose of organizing or acquiring........ 10, 179–181, 217

Sulphate of ammonia:
- American Coal Products Co.—
  - Commissions received by........ 52
  - Exclusive contracts........ 7, 49–52
  - Influence upon prices........ 138
  - Sales by........ 49–51
  - Sales policy........ 52–53
- Ammonia content........ 37
- Consumption of, in United States........ 29–30, 45–46
  - For fertilizer, estimated, 1913........ 6, 175
- Dealt in on Manchester Exchange........ 135
- Description of........ 36–37
- Excess cost of production over ammonia liquor........ 44
- European methods of handling........ 47
- European production and sale........ 46–48
- Fertilizing value of........ 37
- Imports of........ 44–46
- Prices........ 129–137
  - Per unit of nitrogen, 1909–1914........ 157–158
- Processes for recovery of........ 38–40
- Producers, domestic........ 40–42
- Production, by United States Steel Corporation, 1913........ 43
  - By years, domestic........ 42
  - Compared with ammonia liquor........ 43

Sulphate of ammonia—Continued. Page.
  Propaganda 53–54
  Sales by American Coal Products Co 49–51
  Sources of 37
  Synthetic 32
  Terms of sale 48
  Used by seven large companies, 1913 173
  Uses 46
Sulphate of potash used by seven large companies, 1913 174
  (*See also* Potash.)
Sulphur Mining & Railroad Co., subsidiary of Virginia-Carolina Chemical Co 191
Sulphuric acid:
  Consumption by classes of consumers, estimated 102
  Principal producers 102
  Process of production 102
  Production, 1913 102
    By Tennessee Copper Co., 1912–13 103
  Use of, in acid phosphate 89–90
  Uses for fertilizer 101
Sulzberger & Sons Co 67
Superphosphate. (*See* Acid phosphate.)
Surf days, nitrate ports 27, 127
Swainsboro Fertilizer Co., identification of 206
Swift & Co.:
  Brands of certain formulas, number of, South Carolina, 1913–14 221
  Brands registered in certain States, number of, 1913 and 1914 218–219
  Cotton-oil mills 64–65
  Fertilizer business of 209
  Fertilizer materials used in 1913 173–174
  Phosphate-rock properties 99, 100, 210
  Plants, acid phosphate 90
    Location and character of 209–210
    Number of, in United States, by classes, 1914 179
    Operated in Alabama, Georgia, South Carolina, by classes, 1914 190
  Producer of tankage, etc 67
  Purchaser of tankage, etc 150
  Sales, bagged and bulk goods, 1913 173
    In four States, 1914 176
  Violation of Texas antitrust law 65–66
Swift Fertilizer Works, owned by Swift & Co 209
Sylvinit, crude potash salt 105
Syndicate prices of potash salts 155–156
Synthetic sulphate of ammonia, process 39
  Effect on prices 137
Syracuse Rendering Co., identification of 210–211

Tankage:
  Competition from foreign 150–151
  Consumption for fertilizer, domestic, estimated, 1913 6, 175
  Description and process of production 66–67
  Imports of 69
  Prices 144–150, 156–160
  Production, estimated domestic 70–72
    By large packers 72–74
  Purchases by large packers 69, 72–74

Tankage—Continued. Page.
  Speculation in 76
  Storage facilities of large packers 70
  Terms of sale, etc 74–76
  Used by seven large companies, 1913 173
  Uses of 73
Taxes, brand 11
  Tonnage, registration, license, etc 14
Tennessee, prices cottonseed meal, 1907–1914 139–140
  Phosphate rock—
    Location of deposits 99
    Miners of 99–100
    Production by years, 1904–1914 95–96
Tennessee Chemical Co., identification of 201
Tennessee Copper Co.:
  Sulphuric-acid contract with International Agricultural Corporation 204
  Sulphuric-acid production, 1912–13 103
Tennessee Fertilizer Co., leased to International Agricultural Corporation 207
Texas *v.* Ehle Mills et al 65–66
Thomas & Son Co., I. P 213
Thomas slag or Thomas phosphate. (*See* Basic slag phosphate.)
Thomasville Fertilizer Co., identification of 184
Tonnage, fertilizer four large companies, 1910–1914 223–228
Tunnell & Co. (Inc.), F. W 213
Tuscarora Fertilizer Co., identification of 201
Tygert Co., The J. E., identification of 195

Union Fertilizer Co., identification of 206
Union Guano Co., identification of 184
Union Seed & Fertilizer Co., The, subsidiary of American Cotton Oil Co 61, 212
Union Springs Guano Co., identification of 206
Unit prices of ammoniates and nitrates 156–160
United Coke & Gas Co., acquired by American Coal Products Co 51
United Kingdom, exports of sulphate of ammonia 48
  Exports of sulphate of ammonia to United States 45
  Production and sale of sulphate of ammonia 46–47
United-Otto coke ovens, number in operation, 1914 40–41
United Phosphate & Chemical Co., subsidiary of Virginia-Carolina Chemical Co 191
United States Steel Corporation, largest domestic producer of sulphate of ammonia 43
Upshur Guano Co., R. L., identification of 213
Uruguay, American packers in 68

Venable Fertilizer Co., identification of 213
Vermont Agricultural Experiment Station:
  Availability of base goods 78–79
  Multiplication of brands 221–223
  Saving effected by home mixing 235
Victor Guano Co., identification of 212
Virginia-Carolina Chemical Co.:
  Brands, number of registered 223
    Number registered in certain States, 1913 and 1914 218–219
    Number of certain formulas, South Carolina, 1913–14 220
  Companies acquired prior to 1902 182–183

Virginia-Carolina Chemical Co.—Continued. Page.
Control, extent of ... 189–190
Of affiliated companies ... 10–11, 188
Of Southern Cotton Oil Co ... 60
Fertilizer materials used, 1913 ... 173–174
Good-will account ... 182
Identification of companies ... 184–185
Interest in Colonial Development Co. (Ltd.) ... 241
Organization and capitalization ... 172, 181–182
Plants, acid phosphate ... 90
Location of ... 175
Number and character of, by States, 1914 ... 185
Number of in United States, by classes, 1914 ... 179
Number operated, by classes, 1914 ... 190
Phosphate properties ... 99, 100, 190–191
Policy of acquiring interest in small companies ... 180
Potash contract ... 116
Price lists adopted by other companies ... 216
Sales of, bagged and bulk goods, 1913 ... 173
In four States, 1914 ... 176
Selling companies ... 180
Tankage, purchases of, 1913 ... 149

Walter Co., The Edward J., exclusive selling agent ... 7
Washington, Alexander & Cooke, identification of ... 184–185
Waste materials, for fertilizer purposes ... 66
Weber & Co., nitrate exports of, by years, 1910–1913 ... 26
Welch Fertilizer Co ... 212
Wessel, Duval & Co.:
Control of nitrate of soda prices ... 129
Importer of nitrate of soda ... 8, 30–31
West Coast Line of Steamers, owned by Wessel, Duval & Co ... 31
Wet mixers, operations of ... 9
Plants in United States, by States, 1914 ... 177–178
Wet mixing process, description of ... 177
Whann Co., W. E., identification of ... 195
White phosphate rock deposits, location of ... 99
Wholesale prices. (*See* Prices.)
Wilcox, Ives & Co ... 214
Wilputte, coke ovens, number in operation, 1914 ... 40–41
Wilson & Toomer Fertilizer Co ... 214
Potash contract ... 116
Wooldridge Co., The Robert A., identification of ... 195
Worcester Rendering Co., identification of ... 211

Yearly contracts, for tankage ... 150

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